



ADVANCED CALCULUS FOR ENGINEERS

PROF. JITENDRA KUMAR

Department of Mathematics
IIT Kharagpur

PROF. SOMESH KUMAR

Department of Mathematics
IIT Kharagpur

PRE-REQUISITES : Higher Secondary

INTENDED AUDIENCE : All branches of science and engineering

COURSE OUTLINE :

This course is about basic mathematics, which is a fundamental and essential component of all undergraduate studies in sciences and engineering. This course consists of topics in differential, integral, and vector calculus with applications to various engineering problems. This course will cover calculus of two or more variables in detail. Knowledge of ordinary differential equations are part of this course. Students will learn how to perform double and triple integrals. Topic in vector calculus includes line and surface integrals, Green, Gauss and Stokes theorem.

ABOUT INSTRUCTOR :

Prof. Jitendra Kumar is a Professor at the Department of Mathematics, IIT Kharagpur. He completed his M.Sc. in Industrial Mathematics from IIT Roorkee and then from Technical University of Kaiserslautern, Germany. He was awarded a doctorate in 2006 from Otto-von-Guericke University Magdeburg, Germany. After completing his Ph.D., he was offered a lectureship at the Institute for Analysis and Numerical Mathematics, Otto-von-Guericke University Magdeburg, Germany. Dr. Kumar is the recipient of several recognized awards and fellowships, including the Alexander von Humboldt fellowship, DAAD & DGF scholarships. His research interests include Numerical solutions of integro-differential equations, numerical analysis and modelling and simulations of problems in particulate systems.

Prof. Somesh Kumar is a professor in the Department of Mathematics, IIT Kharagpur. He has over 32 years of experience of teaching courses on Probability Statistics, Statistical Inference, Sampling Theory, Stochastic Processes, Multivariate Analysis, Regression Analysis, Time Series, Experimental Designs, Decision Theory to undergraduate, postgraduate and doctorate students. His NPTEL courses (under MHRD) on Probability and Statistics, Statistical Inference and Statistical Methods for Scientists and Engineers (each of 40 hours) are available online and very popular. He has also taught Mathematics-I in QEEE program of MHRD to 130 engineering college students in online mode during Autumn 2014-2015. He offered the course "Probability and Statistics" for certification program in Jan-April 2016, Jan-April 2017, Jan-April 2019. He also offered the course "Statistical Inference" for certification program during Jan-April 2019. His lectures on "Probability" and "Permutation and combinations" for class XII students under IIT-PAL scheme of MHRD are also available through DTH channels of national television. His research interests are Statistical Decision Theory, Estimation Theory, Testing of Hypothesis, Classification Problems, Directional Distributions, Limit Theorems. He has published more than 100 research papers in refereed reputed international journals and book chapters. He has supervised eleven Ph.D. students and more than two hundred fifty Masters (M.Tech./ M.Sc./B.Tech.) dissertations. He has been guest professor in University of Ulm, Germany in July 2017 and June-July 2018 and in University of Dortmund in May-June 2019. He is Principal Investigator for a major research project "Drone for Vaccine Delivery" funded by the Indian Council for Medical Research. He has delivered invited lectures in various universities in India and abroad.

COURSE PLAN :

Week 1: Differential calculus of one variable

Week 2: Limit, continuity, partial derivatives of functions of two or more variables

Week 3: Differentiability of functions of two or more variables

Week 4: Differentiation of Homogeneous and Implicit Functions, Taylors theorem of functions of two variables

Week 5: Maxima and Minima

Week 6: First order ODEs

Week 7: Higher order ODEs

Week 8: Improper integrals

Week 9: Double integrals

Week 10: Triple Integrals

Week 11: Vector and scalar field, gradient, divergence and curl

Week 12: Line and surface integrals. Green, Stokes and Gauss divergence theorems



ADVANCED ROBOTICS

PROF. ASHISH DUTTA

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : Basic Mathematics : matrices, differential equations

INTENDED AUDIENCE : Students (UG 3rd/4th year in Mechanical/Electrical/Computer Science), Teachers of engineering colleges, Industry professorial

INDUSTRY SUPPORT : All Manufacturing companies (TATA motors, Mahindra, Maruti, Hyundai, GE, GM, etc), IT companies (TCS, Infosys, etc), process industries using robotics

COURSE OUTLINE :

The course is intended as a second level course for students, teachers and industry personal interested in learning the advanced concepts in robotics, as required in the design and control of robotic systems. This course is not intended as a basic course for learning robotics. The course starts with an introduction to robotics, linkages and workspaces, transformations, kinematics, trajectory planning and dynamics. Next, singular value decomposition is introduced to explain the concept of manipulation ability that is followed by the basics of linear control methods. The course also introduces advanced topics like modeling and analysis of multi-finger grasping, legged robots, their design and optimization with real world applications.

ABOUT INSTRUCTOR :

Prof. Ashish Dutta obtained his PhD in Systems Engineering from Akita University, Japan, M.Tech from Jadavpur University and B.Tech from NIT Calicut. From 1994 to 2000 he was with the Bhabha Atomic Research Center, Mumbai where he worked on telemanipulator design and control for nuclear applications. Since 2002 he is with the department of mechanical engineering at IIT Kanpur, India. He was also a visiting professor in Nagoya University, Japan in 2006 and is currently a visiting professor at Kyushu Institute of Technology, Japan (2015 -). His research interests are in the areas of humanoid robotics, motion planning in 3D, intelligent control systems and rehabilitation engineering. Prof. Dutta has also served as advisory board member of ISRO Chandrayan II Lunar mission (2009), member of Task force on AI of the Ministry of Commerce and Industry (2017), Secretary of The Robotics Society of India (2011-2017), member Bureau of Indian Standards (Robotics Section), Chairman India-South Korea robotics working group (2013-), Chairman IEEE Robotics and Automation section (UP, UK section), etc.

COURSE PLAN :

Week 1: Introduction, transformations

Week 2: DH Parameters

Week 3: Forward and Inverse Kinematics, redundancy resolution

Week 4: Velocity kinematics and Jacobian

Week 5: Singular value decomposition, singularity and manipulation ability

Week 6: Trajectory planning, dynamics

Week 7: Sensors and actuators as used in robotics

Week 8: Basics of linear control – PD, PID controller, model based control, stability

Week 9: Multi finger grasping – form, force closures, grasp matrix

Week 10: Locomotion – active and passive walkers, concepts of balance

Week 11: Biped Gait and Balance using ZMP, kinematics and dynamic modeling of walk

Week 12: Design and Optimization of legged mechanisms



ADVANCED THERMODYNAMICS AND MOLECULAR SIMULATIONS

PROF. PRATEEK KUMAR JHA

Department of Chemical Engineering

IIT Roorkee

PRE-REQUISITES : Basic UG course in thermodynamics or statistical mechanics

INTENDED AUDIENCE : First year postgraduate and fourth year undergraduate students in Chemical Engineering, Chemistry, Materials Science, Polymer Science, Nanotechnology, Mechanical Engineering

INDUSTRIES APPLICABLE TO : Pharmaceutical, FMCG, Chemical, and Oil companies.

COURSE OUTLINE :

This course aims to impart knowledge of advanced thermodynamics concepts and molecular simulation methods. Unlike the standard undergraduate chemical engineering thermodynamics, we will follow a rather physics-based treatment of thermodynamics based on statistical mechanics concepts and molecular theories. The thermodynamics part to be covered in first half of the course would be used in the discussion of molecular simulations to be covered in the second half of the course. At the successful completion of the course, students are expected to be able to 1. Apply thermodynamic concepts in the understanding of chemical engineering problems and their research work. 2. Identify the molecular simulation approach best suited for a problem, perform simulation and analyze results.

ABOUT INSTRUCTOR :

Prof. Prateek Jha is an associate professor in the Department of Chemical Engineering, IIT Roorkee, India. His research interests are in the areas of molecular simulations, drug delivery, polymer physics, and theoretical nanoscience. He has earned his PhD from Northwestern University, followed by a postdoctoral stint at University of Michigan-Ann Arbor on a collaborative project with The Dow Chemical Company. He has won several awards including institute research fellowship of IIT Roorkee awarded to outstanding young faculty, DST young scientist award, DST-INSPIRE award, and distinguished researcher award for his PhD work at Northwestern University. He was a finalist for Frank J. Padden Jr. Award for excellence in polymer physics research of the American Physical Society in 2012. He has earned his undergraduate and master's degree from NIT Warangal (India) and IIT Bombay (India), respectively.

COURSE PLAN :

Week 1: Introduction and scope of the course. Probability and distributions. Boltzmann approximation and concept of thermodynamic Equilibrium. Molecular origin of entropy.

Week 2: Laws of thermodynamics, thermodynamic functions, Legendre transformation, Maxwell relations.

Week 3: Averages and fluctuations, Method of Lagrange multipliers. Introduction to thermodynamic ensembles, partition function.

Week 4: Derivation of thermodynamic properties in different ensembles, definition of temperature.

Week 5: Phase equilibrium, Gibbs phase rule, mixing and phase separation, chemical potential, osmotic pressure.

Week 6: Lattice model of solutions, phase space and Hamiltonian. Theoretical basis of molecular simulations.

Week 7: Monte Carlo (MC) Simulations: Setting up a simulation, types of boundary conditions, detailed balance.

Week 8: Monte Carlo (MC) Simulations: Numerical implementation, analysis and interpretation of results, case studies.

Week 9: Practical Introduction to Particle Simulations, Molecular Dynamics (MD) Simulations: Numerical integration of equations of motion, force-fields.

Week 10: Molecular Dynamics (MD) Simulations: Temperature and Pressure Control, Analysis and interpretation of results, efficiency and parallelization, case studies.

Week 11: Methods to study phase behavior and coexistence; Methods for Free Energy Calculations: Thermodynamic integration, Widom's particle insertion method, umbrella sampling and other advanced strategies.

Week 12: Non-equilibrium and Mesoscale Simulations: Langevin equations, Brownian dynamics (BD), Kinetic Monte Carlo (kMC) simulations, and other methods; simulations of chemical reactions and quantum chemistry simulations.



AFFECTIVE COMPUTING

PROF. JAINENDRA SHUKLA

Department of Computer Science and Engineering
IIIT Delhi

PROF. ABHINAV DHAL

Department of Computer Science and Engineering
IIT Ropar

PRE-REQUISITES : Mandatory Prerequisites: Programming Artificial Intelligence Machine Learning Desirable Prerequisites:
Human-Computer Interaction Deep Learning

INTENDED AUDIENCE : Senior UG and PG Students

INDUSTRY SUPPORT : In general, any company industry working with AI/ML will recognize this course. Some examples include: Amazon Apple Google Meta Microsoft

COURSE OUTLINE :

Affective Computing focuses on enabling the machines with emotion recognition and adaptive interaction. It lies in the intersection of Computer Science, design and human psychology. This course will overview the emotion theory, computational modelling of emotions, analysis of emotions using different modalities (such as voice, facial expressions, physiological signals etc) and related machine learning and/or signal processing techniques. We will also discuss ethical, legal and social implications of affective computing particularly in relation to Human-Machine Interaction.

ABOUT INSTRUCTOR :

Prof. Jainendra Shukla is the founder and director of the Human-Machine Interaction research group and is an Assistant Professor at the Department of Computer Science and Engineering in joint affiliation with the Department of Human-Centered Design IIIT-Delhi. He is heading the Centre for Design and New Media and is associated with Infosys Centre for Artificial Intelligence. He enthusiastically investigates how empowering social robots and machines with adaptive interaction abilities can improve the quality of life in health and social care. His research has been disseminated in several journals and conferences of international reputation, including CHI, IMWUT, and IEEE Transactions on Affective Computing. He is an active reviewer for several reputed conferences and journals in the field. He has been awarded the startup research grant by SERB, DST, and the research excellence award at IIIT-Delhi. He is the recipient of the prestigious Industrial Doctorate research grant by the Government of Spain in 2014. He received a B.E. degree in Information Technology from the University of Mumbai in First Class with Distinction in 2009. He pursued his M.Tech. Degree in Information Technology with a Specialization in Robotics from the Indian Institute of Information Technology, Allahabad (IIIT-A) in 2012. He received his Ph.D. in excellent grades with Industrial Doctorate Distinction and International Doctorate Distinction from Universitat Rovira I Virgili (URV), Spain, in 2018. He is an active member of the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE). Prof. Jainendra Shukla is the founder and director of the Human-Machine Interaction research group and is an Assistant Professor at the Department of Computer Science and Engineering in joint affiliation with the Department of Human-Centered Design IIIT-Delhi. He enthusiastically investigates how empowering social robots and machines with adaptive interaction abilities can improve the quality of life in health and social care. He has been awarded the startup research grant by SERB, DST, and the research excellence award at IIIT-Delhi. He is the recipient of the prestigious Industrial Doctorate research grant by the Government of Spain in 2014. He received a B.E. degree in Information Technology from the University of Mumbai in First Class with Distinction in 2009. He pursued his M.Tech. Degree in Information Technology with a Specialization in Robotics from the Indian Institute of Information Technology, Allahabad (IIIT-A) in 2012. He received his Ph.D. in excellent grades with Indu

Prof. Abhinav Dhal is Assistant Professor of Computer Science & Engineering and Head of Centre for Applied Research in Data Science at Indian Institute of Technology Ropar. He is also an Adjunct Senior Lecturer at Monash University and Adjunct Faculty at IIIT-Delhi. He received his PhD from Australian National University and later pursued post doc at University of Waterloo and University of Canberra. His research interests are in computer vision and affective computing. He is Associate Editor of IEEE Transactions on Affective Computing

COURSE PLAN :

Week 1: Fundamentals of Affective Computing

Week 2: Emotion Theory and Emotional Design

Week 3: Experimental Design: Affect Elicitation; Research and Development Tools

Week 4: Emotions in Voice

Week 5: Emotions in Facial Expressions

Week 6: Emotions in Text

Week 7: Emotions in Physiological Signals

Week 8: Multimodal Emotion Recognition

Week 9: Emotional Empathy in Agents/Machines/Robots

Week 10: Online and Adaptive Recognition of Emotions: Challenges and Opportunities

Week 11: Case Study: Updated from Time to Time

Week 12: Ethical Issues: Ethical, legal and Social Implications of Affective Computing



AIR POLLUTION AND CONTROL

PROF. BHOLA RAM GURJAR

Department of Civil
IIT Roorkee

INTENDED AUDIENCE : UG and PG (including Pre-PhD)

INDUSTRIES APPLICABLE TO : Industries dealing with emissions and air pollution control may value this course.

COURSE OUTLINE :

The objective of the course is to impart the knowledge and understanding of causes and effects of air pollution and their controlling mechanisms. The course will provide a deeper understanding of air pollutants, pollution inventory and modelling. The course also imparts knowledge on the impacts of air pollution on different aspects such as policy, human health and various contemporary technological innovation for betterment of air quality.

ABOUT INSTRUCTOR :

Prof. Bhola Ram Gurjar holds a PhD in the area of Environmental Risk Analysis from India's premier technological institution I.I.T. Delhi followed by Postdoctoral research at the Max Planck Institute in Mainz (Germany). He is a Professor in Civil (Environmental) Engineering and Dean of Resources and Alumni Affairs at Indian Institute of Technology – IIT Roorkee. He has been Head of Centre for Transportation Systems (CTrans) from 2015-2018. He has also headed the Max Planck Partner Group for Megacities & Global Change at IIT Roorkee from 2006-2011. Prof. Gurjar has about 30 years' progressive professional experience in industry, teaching, training, research, and consultancy. He is among the leading academics and researchers who have worked extensively in the area of environmental science and engineering specially focused on air and water pollution, and environmental quality and health risk assessment, which is reflected in his several highly cited research papers published on these themes. His present research interests include megacities; air and water pollution; environmental impact and risk assessment; atmospheric emissions and climate change; Biofuels and their emissions, and integrated cross-disciplinary study of science and policy issues of the environment, health, energy, economy, technology, infrastructure and resources – particularly from the global change, sustainable development and risk governance perspectives.

COURSE PLAN :

Week 1 : Air Pollution: Introduction and Impacts of air pollution on human health, vegetation, animals, building materials, structures, and atmosphere, soil and water bodies.

Week 2 : Sources, classification and formation/transformation of air pollutants: Meteorology and Atmospheric Stability.

Week 3 : Lapse Rate, Plume Behaviour, and Air Quality Monitoring, Air Quality Index (AQI)

Week 4 : Air Quality Modelling, Gaussian dispersion models: point, line and area source models

Week 5 : Emissions Inventory: Transport, Industrial, Agricultural, Residential and Commercial sectors

Week 6 : Application of Remote sensing/Satellite based data in emission inventory, Source apportionment using receptor modelling.

Week 7 : Indoor air pollution: sources, types and health impacts. Sampling, assessment and evaluation of Indoor air quality.

Week 8 : Global and regional environmental issues of air pollution: Ozone depletion, Climate change, Global warming, Acid rain.

Week 9 : Air pollution control devices, equipment and their design.

Week 10 : Air pollution emission standards, National and international policies, acts, rules and regulations.

Week 11 : Emerging technologies and strategies to mitigate air pollution, Current challenges and way forward.

Week 12 : Lab-based measurements of air pollutants.modelling



AIRCRAFT PROPULSION

PROF. VINAYAK N. KULKARNI

Department of Mechanical Engineering
IIT Guwahati

PRE-REQUISITES : Basic UG-level Fluid Mechanics and Thermodynamics

INTENDED AUDIENCE : Undergraduate students of Aerospace and Mechanical engg. (5th semester onwards) and postgraduate students specializing in the thermofluids/Fluid Mechanics/Automobiles; industry personnel associated with aerospace engineering; faculty members associated with Mechanical /Aerospace engg.

COURSE OUTLINE :

This course deals with the gas power cycles for aircraft propulsion. Therefore different types of aircraft engines, their parts and their performance parameters are discussed. Then the cycle analysis and its different attachment for improvisation are also focused. Further, different parts of aircraft engines like compressor, turbines, combustor and nozzle are discussed in detail.

ABOUT INSTRUCTOR :

Prof. Vinayak N. Kulkarni is an Associate Professor in the Department of Mechanical Engineering of Indian Institute of Technology Guwahati since January 2015. He completed his undergraduate studies in Mechanical Engineering in the Shivaji University, Maharashtra, India. His post graduation and PhD is from Aerospace Engineering Department of Indian Institute of Science Bangalore. His teaching interests are basic and applied thermodynamics, gas dynamics, aircraft propulsion and fluid mechanics. His research interests are experimental and computational compressible flows, IC engines and non-conventional energy.

COURSE PLAN :

Week 1: Introduction to Gas turbines and Aircraft Propulsion

Week 2: Aircraft propulsion

Week 3: Ideal and Real cycle analysis

Week 4: Ideal and Real cycle analysis

Week 5: Real cycles

Week 6: Real cycles

Week 7: Engine performance and Engine components

Week 8: Centrifugal Compressors

Week 9: Axial Compressors

Week 10: Axial and Radial Turbines

Week 11: Turbine cooling methods and Component matching

Week 12: Blade design and cascade theory



APPLIED SEISMOLOGY FOR ENGINEERS

PROF. ABHISHEK KUMAR

Department of Electrical Engineering
IIT Guwahati

INTENDED AUDIENCE : Mtech and PhD students on Civil Engineering and Earth Sciences

COURSE OUTLINE :

The present course gives an overview followed by in-depth knowledge about various topics which are required particularly for seismic analysis whether related to determination of seismic loading, understanding dominating fault mechanism in the region, understanding slope stability problems, development of synthetic ground motions, seismic hazard analysis, source characterization, ground response analysis etc. It will help reader to gain deep understanding about above subjects and how these are applied to real life problems. Theoretical explanation followed by numerical problems on above mentioned topics will be covered.

ABOUT INSTRUCTOR :

Dr Abhishek Kumar is currently an Associate Professor at the department of Civil Engineering. He is recipient of Young Engineer Award from Indian National Academy of Engineering (INAE) in the area of Geotechnical Earthquake Engineering and from Institute of Engineers, India. He has received INSPIRE faculty award from DST, Government of India. Currently, he is working with various agencies such as Ministry of Earth Sciences, Nuclear Power Corporation of India Limited, Numaligarh Refinery Limited etc. on various research and consultancy projects. His core research area include seismic hazard analysis, forward and inverse ground response analysis, liquefaction assessment, development of regional ground motion prediction equation etc.

COURSE PLAN :

Week 1: Plate Tectonics, Continental drift Theory

Lecture 1: Plate Tectonics, Continental drift Theory

Week 2: Fault Plane solution

Lecture 2: Fault plane solution, beach ball solution, stereonets cont..

Lecture 3: Fault plane solution, beach ball solution, stereonets cont..

Lecture 4: Fault plane solution, beach ball solution, stereonets

Week 3 : Seismic gaps

Lecture 5: Seismic gap analogy, active and inactive faults cont..

Lecture 6: Seismic gap analogy, active and inactive faults

Week 4: Seismic waves

Lecture 7: Types of seismic waves and wave attenuation cont..

Lecture 8: Types of seismic waves and wave attenuation

Week 5: Seismic hazard analysis

Lecture 9: Seismic source characterization and seismic hazard cont..

Lecture 10: Seismic source characterization and seismic hazard cont..

Lecture 11: Seismic source characterization and seismic hazard cont..

Lecture 12: Seismic source characterization and seismic hazard

Week 6: Ground Motion simulation

Lecture 13: Synthetic ground motion models and development of GMPEs

Week 7: Ground Response Analysis

Lecture 14: Wave equation and its solution, ground response analysis cont..

Lecture 15: Wave equation and its solution, ground response analysis cont..

Lecture 16: Wave equation and its solution, ground response analysis cont..

Lecture 17: Wave equation and its solution, ground response analysis cont..

Lecture 18: Wave equation and its solution, ground response analysis cont..

Lecture 19: Wave equation and its solution, ground response analysis cont..

Lecture 20: Wave equation and its solution, ground response analysis

Week 8 : Liquefaction and its assessment cont..

Lecture 21: Critical state of soil, initiation of liquefaction and simplified approach of liquefaction assessment cont..

Lecture 22: Critical state of soil, initiation of liquefaction and simplified approach of liquefaction assessment cont..

Lecture 23: Critical state of soil, initiation of liquefaction and simplified approach of liquefaction assessment cont..

Lecture 24: Critical state of soil, initiation of liquefaction and simplified approach of liquefaction assessment cont..

Lecture 25: Critical state of soil, initiation of liquefaction and simplified approach of liquefaction assessment

Week 9 : Paleoliquefaction investigations

Lecture 25: Paleoliquefaction investigations

Week 10 : Seismic microzonation practices

Lecture 26: Seismic microzonation practices

Week 11 : Landslide

Lecture 27: Landslide and its classification

Week 12 : Seismic Vulnerability and Risk

Lecture 28: Introduction and quantification of seismic vulnerability and risk cont..

Lecture 29: Introduction and quantification of seismic vulnerability and risk cont..

Lecture 30: Introduction and quantification of seismic vulnerability and risk



ARTIFICIAL INTELLIGENCE (AI) FOR INVESTMENTS

PROF. ABHINAVA TRIPATHI

Department of Industrial and Management Engineering
IIT Kanpur

INTENDED AUDIENCE : Management students (Ph.D. and MBA), Commerce students (B.Com., M.Com.), Chartered Accountants, Finance professionals (Investment analysts, banking professionals, accountants, credit analysts), Engineering graduates

INDUSTRY SUPPORT : Financial Analytics, Data Science & Data Analytics, Business Analytics, Banking & Financial Services, Consulting and Advisory firms, Investment Banks,

COURSE OUTLINE :

Over the next few decades, machine-learning (ML) and AI will transform not only the finance industry but also other industries that borrow significantly from finance. This program has been carefully designed to help future analysts, traders, brokers, consultants and other industry professionals who are either currently exposed to, or foresee artificial intelligence, machine-learning and data science proliferating in their work environment. The operating environment for investment management firms continues to evolve, with technological innovations and shifting investor preferences at the heart of this change. In that context, Artificial Intelligence (AI) is providing new opportunities to both professionals and investors. The objective of this course is to understand the application of Artificial Intelligence and Machine Learning techniques in financial markets, trading, and asset management. This program aims to demonstrate the applications of AI-based models in the finance domain. This includes solving real-life wealth management problems to improve investment decisions with AI.

ABOUT INSTRUCTOR :

Prof. Abhinava Tripathi is a Faculty of Finance and Accounting at IME, Indian Institute of Technology, Kanpur. Previously, he was working at DOMS, IIT Roorkee. He has completed his Ph.D. degree from Indian Institute of Management, Lucknow. He has done his B-Tech. from Indian Institute of Technology, Roorkee and MBA from Indian Institute of Management, Kozhikode. He has more than 5 years of industry experience in investment banking, corporate banking, credit rating, and project finance advisory firms. His current research focuses on the subject of market-microstructure and liquidity in global financial markets. Prof. Abhinava Tripathi has published research papers in international refereed journals, including the Journal of Asset Management, Studies in Economics and Finance, Finance Research Letters, and Managerial Finance, Applied Economics, International Review of Economics and Finance.

COURSE PLAN :

Week 1: Introduction: financial markets, Risk-Return Analysis in Investment Decisions – Measures of Risk and Return

Week 2: Introduction to probability and statistics

Week 3: Statistical Inference: Hypothesis Testing and Confidence Intervals

Week 4: Introduction to R programming

Week 5: Economic Theory of Choice, Market Microstructure and Liquidity (Order-drive vs. Quote-driven markets)

Week 6: Introduction to portfolio construction and optimization

Week 7: Introduction to Asset pricing models, CAPM, Single and Multi-index models

Week 8: Portfolio management and performance evaluation

Week 9: Introduction to tail risk measures-VaR and CVaR

Week 10: Algorithmic trading, trend determination, moving average indicators, momentum indicators

Week 11: AI and Machine Learning in Trading execution and portfolio management: Regression Algorithm and Case Study

Week 12: AI and Machine Learning in Banking and Financial Services: Classification Algorithm and Case Study



AUTOMATION IN MANUFACTURING

PROF. SHRIKRISHNA N. JOSHI

Department of Mechanical Engineering
IIT Guwahati

PRE-REQUISITES : Knowledge of basic electronics and electrical engineering.

INTENDED AUDIENCE : UG, PG students of Mechanical, Production, Industrial Engineering, Mechatronics Engineering. Practicing engineers.

INDUSTRIES APPLICABLE TO : All automobile manufacturing, mobile phone manufacturing industry, aviation industry

COURSE OUTLINE :

Manufacturing industry contributes a major share in the GDP of our country. Application of automated systems is certainly improving the productivity of the manufacturing industry. In view of this, a course on "Automation in Manufacturing" is designed with the primary focus on the design and development of automated systems in the manufacturing. Initially the course introduces various automated systems being used in the manufacturing industry. Then the building blocks of a typical automated system are described. It presents a study on the principle of operation and construction details of sensors/transducers, actuators, drives and mechanisms, hydraulic and pneumatic systems. It also covers up the microprocessor technology, programming and CNC technology. The contents are lucidly presented with real-life examples. Case studies based on manufacturing industry applications are presented.

ABOUT INSTRUCTOR :

Prof. Shrikrishna N. Joshi has completed his doctoral studies in the area of Intelligent process modeling and optimization of electric discharge machining process from IIT Bombay, Mumbai, India in 2009. Currently, he is working as an Associate Professor in the Department of Mechanical Engineering at Indian Institute of Technology Guwahati, India. He was a visiting faculty at the Asian Institute of Technology (AIT), Bangkok, Thailand in 2015. His research interests include mechatronics and manufacturing automation, CAD/CAM, advanced and precision manufacturing processes with a focus on applications of laser in manufacturing, thin-wall machining and single point diamond turning. Four PhD students have been graduated under his supervision and right now, about 7 students are working on cutting-edge research problems. He has published about 60 research papers and twelve book chapters in refereed international journals and conferences. He has edited two books on "Laser-based manufacturing" and a book on Advances in Computational Methods in Manufacturing with Springer Nature. He has carried out sponsored and consultancy research work of about INR ten millions. The consultancy work was aimed at "Mechanization of Food Grain Handling Operations at FCI Godowns". Dr. Joshi has also developed a web course on Mechatronics and Manufacturing Automation under the scheme of NPTEL of MHRD, Govt. of India. The course was very well appreciated among the engineering industry, academia and research community. He has conducted this course at IIT Guwahati four times for B.Tech final year, M.Tech. and Ph.D students.

COURSE PLAN :

Week 1: Introduction: Importance of automation in the manufacturing industry. Use of mechatronics. Systems required.

Week 2: Design of an automated system: Building blocks of an automated system, working principle and examples.

Week 3: Fabrication: Fabrication or selection of various components of an automated system. Specifications of various elements. Use of design data books and catalogues.

Week 4: Sensors: study of various sensors required in a typical automated system for manufacturing. Construction and principle of operation of sensors.

Week 5: Microprocessor Technology: signal conditioning and data acquisition, use of microprocessor or micro controllers. Configurations. Working.

Week 6: Drives: electrical drives – types, selection criteria, construction and operating principle.

Week 7: Mechanisms: Ball screws, linear motion bearings, cams, systems controlled by camshafts.

Week 8: Mechanisms: Electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Week 9: Hydraulic systems: hydraulic power pack, pumps, valves.

Week 10: Hydraulic systems: designing of hydraulic circuits.

Week 11: Pneumatic systems: configurations, compressors, valves, distribution and conditioning.

Week 12: CNC technology: basic elements, interpolators and programming.



BASIC PRINCIPLES AND CALCULATIONS IN CHEMICAL ENGINEERING

PROF. SUBRATA KUMAR MAJUMDAR

Department of Chemical Engineering

IIT Guwahati

PRE-REQUISITES : 10+2 Examination in science

INTENDED AUDIENCE : Chemical, BioChemical, chemical science and Technology / Chemical Engineering Petroleum science and technology

INDUSTRIES APPLICABLE TO : Industrial Research and development section of chemical and Biochemical Engineering

COURSE OUTLINE :

The objective of the course is to introduce chemical engineering students to the basic principles and calculation techniques used in the chemical industries and to acquaint them with the fundamentals of the material and energy balances as applied to chemical engineering processes. The course is mainly intended for graduate chemical engineering student. It will expose them to solve the problems in material and energy balances that arise in relation to the problems involving in different chemical process units. It also will introduce them to numerical methods used to solve the problems. The course will introduce in simple language and ample of examples so that it will encourage learners to get used to the course.

ABOUT INSTRUCTOR :

Prof. Subrata Kumar Majumder is a Professor in the Chemical Engineering Department, IIT Guwahati, India. His research interests include multiphase flow and reactor development, hydrodynamics in multiphase flow, mineral processing, process intensifications and micro-nano bubble science and technology and its applications. He is a Fellow of the International Society for Research and Development, 8A Kapteinsvigein, London, UK. He is also a recipient of various honours and awards like: Editor, Journal of Chemical Engineering Research Studies, Guest editor, American Journal of Fluid Dynamics, published by Scientific & Academic Publishing Co., CA, 91731, USA, Editorial board member of Scientific Journal of Materials Science, IIME Award on beneficitation from Indian Institute of Mineral Engineers (IIME), Editorial board Member of the Journal of Science and Technology, Scientific and Academic Publishing, USA, Advisory board member of Excelling Tech Publishers (ETP), London, UK. He is a life member of Indian Institute of Chemical Engineers, Indian Institute of Mineral Engineers, member of Institute of Engineers (India), Member of Asia-Pacific Chemical, Biological & Environmental Engineering Society (PCBEE), senior member of International Association of Engineers (IAE), Japan. He authored four books, five book chapters, and has more than 80 publications in several reputed international journals. Presently he is working in the field of Microbubble science and technology and its applications in mineral beneficiation, food processing and arsenic, ammonia and dye removal and process intensifications by developing ejector-induced gas aided extraction process.

COURSE PLAN :

Week 1: Introduction

Contents:

Definition, history and role of chemical engineers: Definition of chemical engineering, role of chemical engineers in society

Basic features of chemical process: Classifications and modes of chemical processes; basic features of chemical process and unit operation

Unit systems and dimensions: Dimensional homogeneity and its analysis, Analysis of problem with solution

Week 2: Process Variables and Rate

Contents:

Variables and properties of material in systems: Physical and transport properties of materials and mixtures, Analysis of problem with solution

Pressure and temperature of flow process: Pressure and temperature and their measurements in flow process, problem solving

Rate of chemical processes: Flow rate and its measurements, Flow rate and its measurements, Rate of momentum transfer, Rate of heat transfer, Rate of mass transfer, Analysis of problem with solution Solving problems3

Week 3: Fundamentals of Material Balance

Contents:

Principles of material balance and its calculation: basis of engineering calculations, the general material balance equation, Balances on single and multiple unit processes without reaction, Solving problems

Material balances on non-reactive processes: Material balances on non-reactive processes with recycle and bypass, Solving problems

Material balances on reactive processes: Material balances on reactive processes, Solving problems

Material balances on combustion processes: Material balances based on combustion reactions, Solving problems

Week 4: Basic Principles of Compressible System

Contents:

State equation of ideal gas and calculation: Basic equations of state for ideal gas and their calculations;

State equation of non-ideal gas and calculation: Basic equations of state for non-ideal gas and their calculations

Week 5: Basic Principles of Multiphase System

Contents:

Phase equilibrium and Vapour Pressure: Phase equilibrium, Gibb's phase law, Clausius-Clapeyron Equation, Antoine's Equation, Cox Chart

Equilibrium laws: Raoul's Law, Henry's law, volatility, their calculations with examples

Saturation and Humidity: Principles of saturation, humidity, Psychrometric chart and its use, problem solving

Process of phase change: Condensation, vaporization, Examples

Week 6: Energy and Its Forms

Contents:

Principles of Energy: concepts and units, Different forms of energy and their calculations, The general energy balance equation

Laws and Properties of thermodynamics: Laws of thermodynamics, definitions of thermodynamic properties like Heat capacity, enthalpy, entropy; Calculation of enthalpy changes (without change of phase), enthalpy changes for phase transitions

Heat of formation, reaction and solution: Definition and calculations

Week 7: Energy Balances on Non-reactive Processes

Contents:

The mechanical energy balance: basic understanding with example

Enthalpy balances without reaction: basic understanding with example

Energy balances on non-reactive processes of multiple inlet and outlet streams: basic understanding with example

Enthalpy balances for heat of solution: Analysis with example

Week 8: Energy Balances on Reactive Systems

Contents:

Energy balance with standard heat of reaction: basic understanding with example

Energy balance with heat of reaction: basic understanding with example

Energy balances on heat of combustion: basic understanding with example

Week 9: Balances on Unsteady State Processes

Contents:

Material balances of unsteady state process: basic understanding with example

Unsteady state energy balance: basic understanding with example; Example of simultaneous material and energy balance

Week 10: Computational Techniques

Contents:

The methods of least squares: Linear equation fitting with experimental data with example

Non-linear algebraic equation system: basic understanding with example

Numerical Integration: basic understanding with example

Week 11: Computer-aided Balance Calculations

Contents:

Degree of freedom analysis: basic understanding with example

Process flow sheeting and codes: basic understanding

Week 12: Case Studies on Chemical Process

Contents:

Case study-I on chemical process: Analysis with example

Case study-II on chemical process: Analysis with example 3



BIG DATA COMPUTING

PROF. RAJIV MISRA

Department of Computer science and engineering
IIT Patna

PRE-REQUISITES : Data Structure & Algorithms, Computer Architecture, OperatingSystem, Database Management Systems

INDUSTRY SUPPORT : Companies like Amazon, Microsoft, Google, IBM, Facebook

COURSE OUTLINE :

In today's fast-paced digital world , the incredible amount of data being generated every minute has grown tremendously from sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction records, and GPS signals from cell phone to name a few. This amount of large data with different velocities and varieties is termed as big data and its analytics enables professionals to convert extensive data through statistical and quantitative analysis into powerful insights that can drive efficient decisions. This course provides an in-depth understanding of terminologies and the core concepts behind big data problems, applications, systems and the techniques, that underlie today's big data computing technologies. It provides an introduction to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce, Large scale data storage technologies such as in-memory key/value storage systems, NoSQL distributed databases, Apache Cassandra, HBase and Big Data Streaming Platforms such as Apache Spark Streaming, Apache Kafka Streams that has made big data analysis easier and more accessible. And while discussing the concepts and techniques, we will also look at various applications of Big Data Analytics using Machine Learning, Deep Learning, Graph Processing and many others. The course is suitable for all UG/ PG students and practicing engineers/ scientists from the diverse fields and interested in learning about the novel cutting edge techniques and applications of Big Data Computing.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is working in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelor's of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile, Adhoc and Sensor Networks, Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 70 papers in high quality journals and conferences, and 2 book chapters. His h-index is 10 with more than 590 citations. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, IEEE Systems Journal, Adhoc Networks, Computer Network, Journal of Parallel and Distributed Computing. He has edited a book titled as "Smart Techniques for a Smarter Planet: Towards Smarter Algorithms" for the "Studies in Fuzziness and Soft Computing" book series, Springer (2018). He has supervised four Phd students and currently four Phd students working under his supervision in the area of big data, cloud computing, distributed computing, and sensor networks. He is a senior member of the IEEE and fellow of IETE. He has completed as the Principal Investigator of R&D Project Sponsored by DeITY entitled as "Vehicular Sensor and Mesh Networks based Future ITS". He has mentored the online courses on Cloud Computing, Advanced Graph Theory and Distributed Systems in the platform of NPTEL

COURSE PLAN :

Week 1: Introduction to Big Data

Week 2: Introduction to Enabling Technologies for Big Data

Week 3: Introduction to Big Data Platforms

Week 4: Introduction to Big Data Storage Platforms for Large Scale Data Storage

Week 5: Introduction to Big Data Streaming Platforms for Fast Data

Week 6: Introduction to Big Data Applications (Machine Learning)

Week 7: Introduction of Big data Machine learning with Spark

Week 8: Introduction to Big Data Applications (Graph Processing)



BLOCKCHAIN AND ITS APPLICATIONS

PROF. SANDIP CHAKRABORTY

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SHAMIK SURAL

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Computer Networks; Operating Systems; Cryptography and Network Security

INTENDED AUDIENCE : Undergraduate Students, Postgraduate Students, Industry Associates

INDUSTRIES APPLICABLE TO : IBM; HPE; Intel; Any startups working on Blockchain

COURSE OUTLINE :

In the last few years, Blockchain technology has generated massive interest among governments, enterprises, and academics, because of its capability of providing a transparent, secured, tamper-proof solution for interconnecting different stakeholders in a trustless setup. In January 2021, the Ministry of Electronics and Information Technology (MeiTY), Government of India, published the first draft of the "National Strategy on Blockchain" that highlights 17 potential applications that are of national interest. Against this backdrop, this subject will cover the basic design principles of Blockchain technology and its applications over different sectors. Additionally, the course also provides tutorials on setting up blockchain applications using one of the well-adopted permissionless blockchain platforms -Ethereum, and one permissioned blockchain platform - Hyperledger.

ABOUT INSTRUCTOR :

Prof. Sandip Chakraborty is working as an Associate Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology (IIT) Kharagpur. He obtained his Bachelor of Engineering (BE) degree from Jadavpur University, Kolkata in 2009 and Master of Technology (M Tech) and Doctor of Philosophy (Ph.D.), both from IIT Guwahati, in 2011 and 2014, respectively. The primary research interests of Dr. Chakraborty is in the intersection of Computer Systems, Pervasive Computing, and Human-Computer Interaction. Dr. Chakraborty is leading the System and Mobile Research Lab at IIT Kharagpur, focusing on various aspects of computer systems and networks along with the design and development of ubiquitous and pervasive sensing systems. He is one of the founding members of ACM IMOBILE, the ACM SIGMOBILE chapter in India. He is working as an Area Editor of Elsevier Ad Hoc Networks and Elsevier Pervasive and Mobile Computing journal. He has received various awards and accolades including Excellent Young Teacher Award 2021, INAE Young Engineers' Award, Fellow of National Internet Exchange of India (NIXI), and so on. Further details about his works and publications can be obtained from <https://cse.iitkgp.ac.in/~sandipc/index.html>.

Prof. Shamik Sural is a full professor in the Department of Computer Science and Engineering, Indian Institute of Technology (IIT) Kharagpur. He received the Ph.D. degree from Jadavpur University, Kolkata, India in the year 2000. Before joining IIT Kharagpur in 2002, he spent more than a decade in the Information Technology industry working in India as well as in Michigan, USA. Prof. Sural was a recipient of the Alexander van Humboldt Fellowship for Experienced Researchers in 2009, which enabled him to carry out collaborative research at the Technical University of Munich, Germany. Later in 2018, he was awarded a Humboldt Foundation Alumni Fellowship for a renewed research stay in Germany. He also spent the Fall 2019 semester at Rutgers University, USA as a Fulbright scholar engaged in both teaching and research. During this period, he visited several other universities in the USA for delivering invited lectures. Prof. Sural is a senior member of IEEE and has previously served as the Chairman of the IEEE Kharagpur Section in 2006. He is currently on the editorial boards of IEEE Transactions on Dependable & Secure Computing, IEEE Transactions on Services Computing and Sadhana – a journal of the Indian Academy of Sciences. He has published more than two hundred research papers in reputed international journals and conferences. His research interests include computer security, data mining and multimedia systems.

COURSE PLAN :

Week 1: Introduction to Blockchain Technology and its Importance

Week 2: Basic Crypto Primitives I - Cryptographic Hash

Week 3: Basic Crypto Primitives II - Digital Signature

Week 4: Evolution of the Blockchain Technology

Week 5: Elements of a Blockchain

Week 6: Blockchain Consensus I - Permissionless Models

Week 7: Blockchain Consensus II - Permissioned Models

Week 8: Smart Contract Hands On I - Ethereum Smart Contracts (Permissionless Model) **Week 9:** Smart Contract
Hand On II - Hyperledger Fabric (Permissioned Model)

Week 10: Decentralized Identity Management

Week 11: Blockchain Interoperability

Week 12: Blockchain Applications



BRIEF INTRODUCTION TO PSYCHOLOGY

Prof. Braj Bhushan

Department of Humanities and Social Sciences
IIT Kanpur

INTENDED AUDIENCE : Undergraduate students

COURSE OUTLINE :

This course will be helpful in understanding oneself, one's behaviour, and what lie beneath such behaviour. It will help you understand how we understand, feel, and act. Through this brief introduction to psychology we will cruise through some of the major psychological concepts and principles, primarily focusing on the perceptual processes, learning, memory and emotions.

ABOUT INSTRUCTOR :

Prof. Braj Bhushan is a professor of psychology at IIT Kanpur. His research interest lies in Cognitive Neuropsychology, Cognitive Factors in Design, Trauma Psychology. He has been awarded with many laurels some being "Our Common Future Fellowship (2010), Volkswagen Stiftung, Germany", "Abstract Award (2008), International Association for Suicide Prevention, 3rd Asia Pacific Regional Conference of IASP, Hong Kong", "In Search of Excellence' Award (2004), IAAP and NAOP-I", "Young Scientist Award (2002), Indian Science Congress Association", "B.H.U. Merit and Prize Award (1991), Banaras Hindu University".

COURSE PLAN :

Week 1 : Perception

Week 2 : Learning

Week 3 : Memory

Week 4 : Emotion



BUSINESS ANALYTICS FOR MANAGEMENT DECISION

PROF. RUDRA P. PRADHAN

Department of Management
IIT Kharagpur

PRE-REQUISITES : Basic Statistics, Basic Mathematics, and Basic Management

INTENDED AUDIENCE : Management Students

COURSE OUTLINE :

Students can exposure on data analysis, modeling and spreadsheet use with BUSINESS ANALYTICS for DECISION MAKING. This course will be exclusively quantitative and an application to business/management related problems. It is connected with problem sets and real life cases to know the relevance of a particular problem and the decision making thereof

ABOUT INSTRUCTOR :

Prof. Rudra P. Pradhan is Associate Professor at Vinod Gupta School of Management, IIT Kharagpur. His specialization is Econometric Modeling and Financial Econometrics. His teaching and research assignments are mostly on financial analytics econometric modeling and mathematical modeling.

COURSE PLAN :

Week 1: Introduction to Business Analytics

Week 2: Exploring Data and Analytics on Spreadsheets

Week 3: Descriptive Analytics

Week 4: Inferential Analytics 1

Week 5: Inferential Analytics 2

Week 6: Predictive Analytics 1

Week 7: Predictive Analytics 2

Week 8: Predictive Analytics 3

Week 9: Prescriptive Analytics 1

Week 10: Prescriptive Analytics 2

Week 11: Prescriptive Analytics 3

Week 12: Decision Analytics



BUSINESS FORECASTING

PROF. PANKAJ DUTTA

Department of Management
IIT Bombay

PRE-REQUISITES : Basic Probability and Statistics; The students should be at least in their final year of UG and above

INTENDED AUDIENCE : Students (UG/PG/PhD), faculty, and industry professionals

INDUSTRY SUPPORT : All sectors/companies/industries

COURSE OUTLINE :

Business forecasting is the technique used to cast the foremost business scenarios to ease out the business decisions and management in future. The ongoing development in the field of predictive analytics using data analytics and machine learning techniques helps to shape and analyze the historical data to know the future business possibilities. Utilizing the power of business forecasting allows organizations to handle the uncertainty better and find new possibilities for sustainable growth of business. This course 'business forecasting' will help learners to gain the proficiency in predictive analytics applications and develop the skills to analyze historical data for future demand planning and resource allocation. It will help to understand the key role of forecasting in business planning; understand and know when to use various models of forecasting; the analysis of time series data into various components such as seasonality, trend, and cyclical forecast; understand both qualitative and quantitative forecasting approaches and several business applications of forecasting in marketing, inventory and supply chains, project management, finance and retailing.

ABOUT INSTRUCTOR :

Prof. Pankaj Dutta is Professor in Decision Sciences and Operations Research at Shailesh J. Mehta School of Management, Indian Institute of Technology (IIT) Bombay, Mumbai, India. He holds a PhD degree from IIT Kharagpur, India, and a Postdoctoral Fellow from EPFL, Swiss Federal Institute of Technology, Switzerland. He has worked as INSA Fellow at Karlsruhe Institute of Technology, Germany, and DAAD Visiting Professor at Humboldt University of Berlin, Germany. He served as an associate editor of OPSEARCH and Guest Editor, editorial board member and reviewer of several international journals. He is the central council member of the Operational Research Society of India (ORSI). He has received the departmental Excellence in Teaching Award, several merit/best paper awards & research grants and is also a member of ORSI, ISDSI and PMI, India. Many of his research scholars have received the Best PhD Thesis Award. His current areas of research interest include data analytics, supply chain management, business forecasting, e-commerce analytics, circular economy, multi criteria decision making, and business simulation. He is also interested in portfolio optimization and decision-making under risk and uncertainty. He has several publications in international journals like European Journal of Operational Research, International Journal of Production Economics, Annals of Operations Research, Transportation Research Part E: Logistics and Review, International Journal of Information Management, Information Systems Frontiers, Journal of Cleaner Production, IEEE Transactions on Engineering Management, International Journal of Production Research, Information Systems & E-Business Management, Computers & Industrial Engineering among others

COURSE PLAN :

Week 1:

Lecture 1: Introduction to Business forecasting

Lecture 2: Data Driven Decision Making and Essentials of Predictive Analytics

Lecture 3: Types of Forecasting: Qualitative Approaches and Quantitative Approaches

Week 2:

Lecture 4: Components of a Time Series and Measures of Forecast Accuracy

Lecture 5: Moving Average Methods: Simple, Weighted, and Exponential Moving Average

Week 3:

Lecture 6: Exponential Smoothing

Lecture 7: Trend Projections and Holt Model

Week 4:

Lecture 8: Regression Analysis

Lecture 9: Measure of Goodness and Standard Error

Week 5:

Lecture 10: Seasonality, Seasonal Index, and Quarterly Average Method

Lecture 11: Seasonality and Trend: Holt Winter Method

Lecture 12: Decomposition Method

Week 6:

Lecture 13: ACF and PACF

Lecture 14: ARIMA

Week 7:

Lecture 15: Introduction to Machine Learning

Lecture 16: Logistic Regression

Lecture 17: Human Judgement in Time Series Analysis

Week 8:

Lecture 18: Monte Carlo Simulation and Risk Analytics

Lecture 19: Predictive Analytics using @Risk software/Python



BUSINESS INTELLIGENCE & ANALYTICS

PROF. SAJI K MATHEW

Department of Management Studies
IIT Madras

PRE-REQUISITES : A core course on Business statistics desirable

INDUSTRY SUPPORT : Analytics and data science industry, IT services industry, Manufacturing and services operations and marketing

COURSE OUTLINE :

This course equips students with necessary knowledge and skills on the thought process, modelling approaches and tools required to use data from the enterprise databases and other sources for business decisions. In turn, the course prepares participants for a career in data science, business analytics and market research. This course will introduce the context of data mining, and cover important modelling techniques such as regression, decision trees, clustering, ANN and text mining.

ABOUT INSTRUCTOR :

Prof. Saji K Mathew is currently a Professor at the Department of Management Studies, Indian Institute of Technology Madras, India. As a Fulbright Scholar, he did his post- doctoral research on offshore IT outsourcing at the Goizueta Business School of Emory University, Atlanta (USA). His current research focuses on behavioral cyber security, information privacy, misinformation and digital nudging. He has published research in leading IS journals while also making editorial contributions to some of them. He is a founding member of the Association for Information Systems India Chapter (INAIS) and presently serves as its Vice President.

COURSE PLAN :

Week 1: Introduction to Business Intelligence & Analytics (BIA), drivers of BIA, types of analytics: descriptive to prescriptive, vocabulary of business analytics, course plan and resources

Week 2: Technical architecture of BIA, case analysis of AT&T Long distance, fundamentals of data management, OnLine Transaction Processing (OLTP), design process of databases

Week 3: Relational databases, normalisation, SQL queries, ShopSense case of management questions, data warehousing, OnLine Analytical Processing (OLAP), data cube

Week 4: Descriptive analytics, and visualization, customer analytics, survival analysis, customer lifetime value, case study

Week 5: Data mining process, introduction to statistical learning, data pre-processing, data quality, overview of data mining techniques, case study using regression analysis

Week 6: Introduction to classification, classification techniques, scoring models, classifier performance, ROC and PR curves

Week 7: Introduction to decision trees, tree induction, measures of purity, tree algorithms, pruning, ensemble methods

Week 8: Tree implementation in Python: problem of targeted mailing

Week 9: Cluster analysis, measures of distance, clustering algorithms, K-means and other techniques, cluster quality

Week 10: A store segmentation case study using clustering, implementation in Python, profiling clusters, cluster interpretation and actionable insights, RFM sub- segmentation for customer loyalty

Week 11: Machine learning, Artificial Neural Networks (ANN), topology and training algorithms, back propagation, financial time series modelling using ANN, implementation in Python

Week 12: Text mining, process, key concepts, sentiment scoring, text mining using R-the case of a movie discussion forum, summary



C-BASED VLSI DESIGN

PROF. CHANDAN KARFA

Department of Computer Science and Engineering
IIT Guwahati

PRE-REQUISITES :

1. Basic knowledge of digital design
2. Basic knowledge of Data structures and algorithms
3. Basic knowledge of Verilog.

INTENDED AUDIENCE : Final year BTech Student, MTech and PhD students, engineers from VLSI industries

INDUSTRIES APPLICABLE TO : Synopsys, Cadence, Mentor Graphics, Intel, Xilinx

COURSE OUTLINE :

This course discussed how a C code can be automatically translated into register transfer level (RTL) design using high-level synthesis (HLS). HLS is an active domain of research in recent times in the domain of electronic Design Automation (EDA) of VLSI. This course will help the student to

- (i) understand the overall HLS flow,
- (ii) how a C-code will be converted to its equivalent hardware,
- (iii) how to write c-code for efficient hardware generation and
- (iv) how the common software compiler optimization can help to improve the circuit performance. Also, advanced topics like HLS for FPGA targets, HLS for Security, optimizations at RTL level and verification challenges of HLS will be covered. This course will help the student to take up research in the domain of HLS. Also, this course will help the student to become proficient for EDA industries.

ABOUT INSTRUCTOR :

Prof. Chandan Karfa is an Assistant Professor in the Dept. of CSE, IIT Guwahati since 2016. He has over fifteen years of teaching and research experience. He has so far taught many courses in UG and PG level in IIT Guwahati. He has worked for five years as Senior R&D engineer in EDA Industry in the domain of High-level Synthesis and Logic Synthesis. He has worked as visiting researcher at New York University, May - July 2019. His research interests include High-level Synthesis, CAD for VLSI, Hardware Security and Formal Verification. He has published more than thirty five research papers in reputed international journals and conferences. He has graduated one PhD student and guided twelve MTech and twenty two BTech projects. He is an IEEE Senior member. He was recently awarded the Qualcomm Faculty Award 2021 which recognizes distinguished faculty research that inspires students and sparks new approaches in key technology areas

COURSE PLAN :

Week 1: Introduction to Electronic Design Automation

Week 2: Introduction to C-based VLSI Design: Background

Week 3: Introduction to C-based VLSI Design: HLS Flow

Week 4: C-Based VLSI Design: Scheduling

Week 5: C-Based VLSI Design: Resource allocation and Binding, Data-path and Controller Generation

Week 6: Efficient Synthesis of C Code

Week 7: Hardware Efficient C Coding

Week 8: Impact of Compiler Optimizations in Hardware

Week 9: Verification of High-level Synthesis

Week 10: FPGA Technology Mapping

Week 11: Securing Design with High-level Synthesis

Week 12: Recent Advances in C-Based VLSI Design



CHARACTERIZATION OF CONSTRUCTION MATERIALS

PROF. MANU SANTHANAM

Department of Civil Engineering
IIT Madras

PROF. PIYUSH CHAUNSALI

Department of Civil Engineering
IIT Madras

TYPE OF COURSE : New | Elective | PG
COURSE DURATION : 12 weeks (27 Jan' 20 - 17 Apr' 20)
EXAM DATE : 26 Apr 2020

PRE-REQUISITES : Basic Civil Engineering degree

INTENDED AUDIENCE : Interested Learners

INDUSTRIES APPLICABLE TO : Cement companies, Concrete Producers, Construction chemical manufacturers, Construction companies

COURSE OUTLINE :

The objective of the course is to introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials. The course will be focused primarily on cement and concrete, and include a few techniques; the physics of the techniques and their application to cement science. Lab demonstrations and experiments will be covered.

ABOUT INSTRUCTOR :

Dr. Manu Santhanam is a Professor at the Department of Civil Engineering at IIT Madras. His research interests are in multi-scale characterization of concrete, supplementary cementing materials, durability and non-destructive evaluation

Dr. Piyush Chaunsali is an Assistant Professor at the Department of Civil Engineering at IIT Madras. His research focuses on the use of principles of materials science, life-cycle assessment and structural engineering to design sustainable building materials

COURSE PLAN :

Week 1: Introduction to course; Structure of Construction Materials – An Overview

Week 2: Calorimetry

Week 3: X-ray diffraction

Week 4: X-ray diffraction, cont'd

Week 5: Thermal analysis

Week 6: Surface area measurement

Week 7: Optical microscopy

Week 8: Scanning electron microscopy

Week 9: Image analysis

Week 10: Spectroscopic techniques

Week 11: Mercury intrusion porosimetry

Week 12: Impedance analysis and ultrasonic methods



CHEMICAL PROCESS TECHNOLOGY

PROF. TAMAL BANERJEE

Department of Chemical Engineering
IIT Guwahati

INTENDED AUDIENCE : Undergraduates from Chemical Engineering

INDUSTRY SUPPORT : All the Oil and Gas Major Industries; Bulk and Intermediate; and the Fine Chemicals will be aligned with this course. Moreover the concept of Biorefinery and Sustainable Development for all the Processes shall be discussed.

COURSE OUTLINE :

The course shall bring out concepts forming the basis of the Chemical Process Industry and to give a solid background for innovative process development. It shall discuss the actual industrial processes that presents opportunities and challenges for chemical engineers for the development of these processes. Some of these processes still exhibit open challenges. Our goal is to help students and in developing a vision on chemical processes taking into account the microscale ((bio)chemistry, physics), the mesoscale (reactor, separation units), and the macroscale (the process) domains. Hence the knowledge of these will be helpful for outgoing undergraduates for employment opportunities.

ABOUT INSTRUCTOR :

Prof. Tamal Banerjee earned his Doctorate degree from Indian Institute of Technology Kanpur in the year 2006. Subsequently, he joined the Indian Institute of Technology Guwahati and is currently a Full Professor at the Department of Chemical Engineering from 2017. He has published over 120 papers in reputed peer reviewed Journals. In 2011, he was awarded the Indo-US Fellowship in Engineering Sciences. He has also authored two books each in CRC Press and Elsevier which discusses experiments and molecular modelling aspect of Ionic Liquids as an extractive agent. Prof. Banerjee's research focuses on the use of Ionic Liquids and Deep Eutectic Solvents as green solvents concerning both energy generation and environment mitigation. His group uses both ab-initio methods and Molecular Dynamics methods to predict thermodynamic and transport properties. The properties of interests are primarily in predicting activity coefficients for phase diagrams using Continuum Solvation Model such as COSMO (COnductor like Screening MOdel). His other interests lie in the Reactive Force Field simulations of both renewable (alcohols) and non-renewable (coal and chemical hydrides) energy sources. Recently his group have started evaluating Deep Eutectic Solvents as potential electrolytes and thermal fluids for supercapacitors and solar desalination respectively. He has also initiated thermodynamic pathways using biocompatible gels comprising of Polysaccharide or DES based precursors for drug delivery.

COURSE PLAN :

MODULE 1 : Introduction to Process Development

MODULE 2 : Inorganic Chemical Industries-I

MODULE 3 : Inorganic Chemical Industries-II

MODULE 4 : Industrial Catalysis for Continuous Processes

MODULE 5 : Production of Bulk Chemicals Using Transition Metal Catalyst

MODULE 6 : Sustainable Biorefinery



Cloud Computing

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE,ECE,EE

PREREQUISITES : Basics of Computer Architecture and Organization, Networking

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE:

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

ABOUT THE INSTRUCTOR:

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN:

- Week 1:** Introduction to Cloud Computing
- Week 2:** Cloud Computing Architecture
- Week 3:** Service Management in Cloud Computing
- Week 4:** Data Management in Cloud Computing
- Week 5:** Resource Management in Cloud
- Week 6:** Cloud Security
- Week 7:** Open Source and Commercial Clouds, Cloud Simulator
- Week 8:** Research trend in Cloud Computing, Fog Computing
- Week 9:** VM Resource Allocation, Management and Monitoring
- Week 10:** Cloud-Fog-Edge enabled Analytics
- Week 11:** Serverless Computing and FaaS Model
- Week 12:** Case Studies and Recent Advancements



CMOS DIGITAL VLSI DESIGN

PROF. SUDEB DASGUPTA

Department of Electronics and Communication Engineering
IIT Roorkee

PRE-REQUISITES : A basic course of Semiconductor Devices and Digital Electronics. A course on Computer Organization will be quite helpful.

INTENDED AUDIENCE : Final year Undergraduates and/or First year Master Student (Microelectronics)

INDUSTRIES APPLICABLE TO : Cadence, Synopsys, ST Microelectronics, NXP Semiconductors, SCL, Chandigarh

COURSE OUTLINE :

This course brings circuit and system level views on design on the same platform. The course starts with basic device understanding and then deals with complex digital circuits keeping in mind the current trend in technology. The course follows a design perspective, starts from basic specifications and ends with system level blocks. Eight Assignments are provided which will add/help in understanding the course in a better manner both at conceptual as well as hands-on level.

ABOUT INSTRUCTOR :

Prof. S. Dasgupta, is presently working as an Associate Professor, in Microelectronics and VLSI Group of the Department of Electronics and Communication Engineering at Indian Institute of Technology, Roorkee. He received his PhD degree in Electronics Engineering from Institute of Technology-Banaras Hindu University (currently IIT-BHU), Varanasi in 2000. During his PhD work, he carried out research in the area of effects of ionizing radiation on MOSFET. Subsequently, he was member of faculty of Department of Electronics Engg., at Indian School of Mines, Dhanbad (currently IIT-Dhanbad). In 2006, he joined as an Assistant Professor in the Department of Electronics and Communication Engineering at Indian Institute of Technology, Roorkee. He is currently the Chairman, Faculty Search Committee of the Department. He has authored/co-authored more than 200 research papers in peer reviewed international journals and conferences. His citations are around 2400 (after 2006) and h-index and i-index are 25 and 65 respectively. He is a member of IEEE, EDS, ISTE and associate member of Institute of Nanotechnology, UK. He has been a technical committee member International Conference on Micro-to-Nano, 2006; VDAT-2012, 13, 14, 15, 16, 17 and 18. He worked as the Organising Chair and Program Co-Chair for VDAT-2017 held at IIT Roorkee. He is also heading the Technical Program Group for Emerging Devices at VLSI Design Conference. He has presented tutorial in VDAT-2014 and VLSI Design Conference, Bangalore 2015 amongst many others. He has also been member of technical committees of various international conferences. He has presented large number of invited and keynote talk at various technical forum. He was awarded with Erasmus Mundus Fellowship of European Union in the year 2010 to work in the area of RDF at Politecnico Di Torino, Italy. He is the recipient of prestigious IUSSTF to work in the area of SRAM testing at University of Wisconsin at Madison, USA in the year 2011-12. He was also awarded with DAAD Fellowship to work on Analog Design using Reconfigurable Logic at TU, Dresden, Germany in the year 2013. He is the Principal Coordinator for SMDP-C2SD at IIT Roorkee. His areas of interest are Nanoelectronics, Nanoscale MOSFET modeling and simulation, Design and Development of low power novel devices, FinFET based Memory Design, Emerging Devices in Analog Design and Design and development of reconfigurable logic. He has guided/co-guided 15 Ph.D scholars. Currently he is supervising 7 candidates leading to their Ph.D degree. He has been awarded INAE Young Engineer Award. Dr. Dasgupta acted as a reviewer for IEEE Transactions on Electron Devices, IEEE Electron Device Letters, IEEE Transactions on Nanotechnology, Superlattice and Microstructures, International Journal of Electronics, Semiconductor Science and Technology, Nanotechnology, IEEE Transactions on VLSI Systems, Microelectronic Engineering, and Microelectronic Reliability amongst other.

COURSE PLAN :

Week 1 : MOS Transistor Basic-I; L2: MOS Transistor Basic-I; L3: MOS Transistor Basic-II; L4: MOS Parasitic & SPICE Model; L5: CMOS Inverter Basics-I

Week 2 : CMOS Inverter Basics-II; L2: CMOS Inverter Basics-III; L3: Power Analysis-I; L4: Power Analysis-II; L5: SPICE Simulation-I

Week 3 : SPICE Simulation-II; L2: Combinational Logic Design-I; L3: Combinational Logic Design-II; L4: Combinational Logic Design-III; L5: Combinational Logic Design-IV

Week 4 : Combinational Logic Design-V; L2: Combinational Logic Design-VI; L3: Combinational Logic Design-VII; L4: Combinational Logic Design-VIII; L5: Combinational Logic Design-IX

Week 5 : Combinational Logic Design-X; L2: Logical Efforts-I; L3: Logical Efforts-II; L4: Logical Efforts-III; L5: Sequential Logic Design-I

Week 6 : Sequential Logic Design-II; L2: Sequential Logic Design-III; L3: Sequential Logic Design-IV; L4: Sequential Logic Design-V; L5: Sequential Logic Design-VI

Week 7 : Sequential Logic Design-VII; L2: Sequential Logic Design-VIII; L3: Clocking Strategies for Sequential Design-I; L4: Clocking Strategies for Sequential Design-II; L5: Clocking Strategies for Sequential Design-III

Week 8 : Clocking Strategies for Sequential Design-IV; L2: Sequential Logic Design-IX; L3: Clocking Strategies for Sequential Design-V; L4: Concept of Memory & its Designing-I; L5: Concept of Memory & its Designing-II

Computational Fluid Dynamics - Video course

COURSE OUTLINE

Computational fluid dynamics (CFD) has become an essential tool in analysis and design of thermal and fluid flow systems in wide range of industries. Few prominent areas of applications of CFD include meteorology, transport systems (aerospace, automobile, highspeed trains), energy systems, environment, electronics, bio-medical (design of lifesupport and drug delivery systems), etc.

The correct use of CFD as a design analysis or diagnostic tool requires a thorough understanding of underlying physics, mathematical modeling and numerical techniques. The user must be fully aware of the properties and limitations of the numerical techniques incorporated in CFD software. This course aims to provide precisely these insights of CFD.

Contents:

Mathematical modeling: Governing equations of fluid flow and heat transfer; Introduction to discretization methods: Finite difference and finite volume methods for heat transfer problems; Time stepping methods for unsteady problems; Solution techniques for system of algebraic equations; Grid generation techniques; Solution techniques for Navier-Stokes equation; Finite element method for heat transfer and fluid flow problems; Turbulence modeling.

COURSE DETAIL

Sl. No	Topic	Hours
1.	Introduction: Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description.	3
2.	Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic elliptic and	4



NPTEL

<http://nptel.ac.in>

Mechanical Engineering

Pre-requisites:

Fluid Mechanics.

Coordinators:

Dr. K. M. Singh

Department of Mechanical
and Industrial Engineering IIT
Roorkee

	hyperbolic; boundary and initial conditions; over view of numerical methods.		
3.	Finite Difference Technique: Finite difference methods; different means for formulating finite difference equation; Taylor series expansion, integration over element, local function method; treatment of boundary conditions; boundary layer treatment; variable property; interface and free surface treatment; accuracy of f.d. method.	3	
4.	Finite Volume Technique: Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem.	4	
5.	Finite Element Methods: Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications.	4	
6.	Methods of Solution: Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform.	4	
7.	Time integration Methods: Single and multilevel methods; predictorcorrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems.	4	
8.	Numerical Grid Generation: Numerical grid generation; basic ideas; transformation and mapping.	4	
9.	Navier-Stokes Equations: Explicit and implicit methods; SIMPLE type methods; fractional step methods.	4	

10.	Turbulence modeling: Reynolds averaged Navier-Stokes equations, RANS modeling, DNS and LES.	4

References:

1. Ferziger, J. H. and Peric, M. (2003). Computational Methods for Fluid Dynamics. Third Edition, Springer-Verlag, Berlin.
2. Versteeg, H. K. and Malalasekara, W. (2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method. Second Edition (Indian Reprint) Pearson Education.
3. Anderson, D.A., Tannehill, J.C. and Pletcher, R.H. (1997). Computational Fluid Mechanics and Heat Transfer. Taylor & Francis.



COMPUTATIONAL MATHEMATICS WITH SAGEMATH

PROF. AJIT KUMAR

Department of Mathematics

Institute of Chemical Technology, Mumbai

PRE-REQUISITES : Basic knowledge of Calculus, Linear Algebra and ODE and Numerical Methods.

INTENDED AUDIENCE : UG and PG students of Mathematics and BE Students, Teachers teaching in Degree colleges.

INDUSTRIES APPLICABLE TO : Any industry dealing with Data Science and Numerical Computations.

COURSE OUTLINE :

Computational Mathematics with SageMath: This eight week course aims to use SageMath, a Python based free and open source computer algebra system (CAS) to explore concepts in Calculus, Applied Linear Algebra and Numerical Methods. The course will begin with the introduction of basic Python programming language in the first two weeks. Next we shall provide a quick introduction to SageMath software along with plotting 2D and 3D objects. The main focus will be on using SageMath to explore topics in Calculus, Applied Linear Algebra and Numerical Method along with several applications.

ABOUT INSTRUCTOR :

Prof. Ajit Kumar is an Associate Professor and the Head, Department of Mathematics, Institute of Chemical Technology. He did his Masters and Ph.D. from the University of Mumbai. His current areas of interest are Optimization Techniques, Data Analysis, and Mathematical Pedagogy. He has been a prolific user of various mathematical software such as SageMath, Python, R, Mathematica, MatLab etc. Due to this expertise, he has been invited to give talks on these topics at several national and international events and has conducted numerous training programmes for students and teachers. He has been associated with one of the most popular and significant training programmes in Mathematics known as "Mathematics Training and Talent Search, À (MTTS) Programme for the last several years in various capacities. Currently he is the managing trustee of the MTTS TRUST, which organizes all the programmes under the MTTS umbrella.

COURSE PLAN :

Week 1: Installation of Python;Getting Started with PythonPython as an advanced calculator;Lists in Python Tuple, Sets and Dictionaries in Python;Functions and Branching.

Week 2: For loop in Python;While loop in Python;Creating Modules and Introduction to NumPy;Use of NumPy module;Python Graphics using Matplotlib

Week 3: Use of SciPy and SymPy in Python;Classes in Python - Part 01;Classes in Python - Part 02;Introduction and Installation of SageMath;Exploring integers in SageMath

Week 4: Solving Equations in SageMath;2d Plotting with SageMath;3d Plotting with SageMath;Calculus of one variable with SageMath - Part 1;Calculus of one variable with SageMath - Part 2;Applications of derivatives

Week 5: Integration with SageMath;Improper Integral using SageMath;Application of integration using SageMath;Limit and Continuity of real valued functions;Partial Derivative with SageMath;Local Maximum and Minimum

Week 6: Application of local maximum and local minimum;Constrained optimization using Lagrange multipliers;Working with vectors in SageMath;Solving system of linear Equations in SageMath;Vector Spaces in SageMath ;Basis and dimensions of vector spaces in SageMath

Week 7: Matrix Spaces with SageMath;Linear Transformations Part 1 with SageMath;Linear Transformations Part 2 with SageMath;Eigenvalues and Eigenvectors Part 1 with SageMath;Eigenvalues and Eigenvectors Part 2 with SageMath

Week 8: Inner Product Part 1 with SageMath;Inner Product Part 2 with SageMath;Orthogonal Decomposition with SageMath;Least Square Solution with SageMath;Singular Value Decomposition (SVD) with SageMath;Application of SVD to image processing;Solving System of linear ODE using Eigenvalues and Eigenvectors;Least Square Solution with SageMath;Singular Value Decomposition (SVD) with SageMath;Application of SVD to image processing;Solving System of linear ODE using Eigenvalues and Eigenvectors

Week 9: Google Page Rank Algorithm using SageMath;Finding Roots of algebraic and transcendental equations in SageMath;Numerical Solutions of System of linear equations in SageMath ;Interpolations in SageMathNumerical Integration in SageMath;Numerical Eigenvalues

Week 10: Solving 1st and 2nd order ODE with SageMath;Euler's Method to solve 1st order ODE with SageMath;Fourth Order Runge-Kutta Method ;RK4 method for System of ODE and Applications;Solving ODE using Laplace Transforms in SageMath

Week 11: Introduction to Linear Programming Problems (LPP);Solving Linear Programming Problems using Graphical Methods;Basics Definitions and Results in LPP;Theory of Simplex Method;Simplex Methods in SageMath - Part 01;Simplex Methods in SageMath - Part 02;Simplex Methods in Matrix Form.

Week 12: Revised Simplex Method in SageMath;Two Phase Simplex Method in SageMath;Big-M Method in SageMath Duality of Linear Program;Dual Simplex Method in SageMath;Review and What next in SageMath?

COMPUTER GRAPHICS

COURSE LAYOUT

Week 1 : Introduction – historical evolution, issues and challenges, graphics pipeline, hardware and software basics

Week 2 : Object representation – boundary representation, splines, space partitioning

Week 3 : Modeling transformations – matrix representation, homogeneous coordinate system, composition, 3D transformations

Week 4 : Illumination and shading – background, simple lighting model, shading models, intensity representation, color models, texture synthesis

Week 5 : 3D viewing – viewing pipeline, view coordinate system, viewing transformation, projection, window-viewport transformation

Week 6 : Clipping and hidden surface removal – clipping in 2D. 3D clipping algorithms, hidden surface removal

Week 7 : Rendering – scan conversion of line, circle, fill-area and characters, anti-aliasing

Week 8 : Graphics hardware and software – generic architecture, I/O, GPU, Shader programming, graphics software (openGL)



COMPUTER INTEGRATED MANUFACTURING

PROF. JANAKARAJAN RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Use of computers in manufacturing in order to design and develop the products has found unprecedented applications. Computer integrated way of manufacturing provides a myriad of benefits such as speed, flexibility, and better control. In this course, Computer Integrated Manufacturing (CIM) approaches are discussed. CAD/CAM tools and their within and between the production systems are presented along with appropriate case studies. Data storage and handling is also the need of contemporary manufacturing systems. This is also catered using software tools. The course is reinforced with the laboratory demonstrations to add a practitioners' touch. Students would develop a prowess to largely plan, design and develop a product and a production system after completing this course

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers

Prof. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1: Introduction to Computer Integrated Manufacturing (CIM)

Week 2: Computer Aided Design

Week 3: Computer Aided Manufacturing

Week 4: Computer Numerical Control

Week 5: Computer Aided Process Planning (CAPP)

Week 6: CIM interfaces: CAD vs CAM

Week 7: Data and information in CIM

Week 8: Manufacturing Systems and their design

Week 9: Simulation of Manufacturing Systems

Week 10: Computer Aided Maintenance

Week 11: Computer Integrated Additive Manufacturing

Week 12: Advanced CIM techniques



COMPUTER NETWORKS AND INTERNET PROTOCOL

PROF. SOUMYA KANTI GHOSH

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SANDIP CHAKRABORTY

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE, ECE, EE students

INDUSTRIES APPLICABLE TO : IT industries

COURSE OUTLINE :

The domain of Internet has grown in a rapid pace from traditional circuit switched and packet switched small scale networks to modern high-speed mobile and wireless Internet. A large number of methods, architectures and designs came up at every protocol level to cope up with the demands for developing a secure and highly dependable information technology infrastructure. The broad objective of the course is to understand - (i) the architecture and principles of today's computer networks, (ii) the protocols and their functionalities, (iii) the requirements for the future Internet and its impact on the computer network architecture. In this course, we'll broadly cover the basic TCP/IP protocol stack and touch on the next generation computer networks. We'll take a top-down approach to cover different protocols at the TCP/IP protocol stack.

ABOUT INSTRUCTOR :

Prof. Soumya K. Ghosh received Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT, Kharagpur. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

Prof. Sandip Chakraborty received Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT, Guwahati. Presently, he is an Assistant Professor with Department of Computer Science and Engineering, IIT Kharagpur. He has around 100 research papers in reputed journals and conference proceedings. His research interests include computer systems, distributed systems and mobile computing.

COURSE PLAN :

- Week 1 :** Introduction to Computer Networks History, Circuit Switching and Packet Switching
- Week 2 :** TCP/IP Protocol Stack – Basic Overview
- Week 3 :** Application Layer Services (HTTP, FTP, Email, DNS)
- Week 4 :** Transport Layer Primitives – Connection Establishment and Closure
- Week 5 :** Flow Control and Congestion Control at the Transport Layer
- Week 6 :** Transmission Control Protocol – Basic Features, TCP Congestion Control
- Week 7 :** Network Layer Primitives – IP Addressing
- Week 8 :** IP Routing – Intra Domain Routing Protocols, Inter Domain Routing Protocols (BGP)
- Week 9 :** IP Services – SNMP, ARP
- Week 10 :** Data Link Layer Service Primitives – Forwarding, Flow Control, Error Control
- Week 11 :** Media Access Control - Channel Access Protocols, Framing
- Week 12 :** End to End Principles of Computer Networks



COMPUTER VISION

PROF. JAYANTA MUKHOPADHYAY

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Linear Algebra, Vector Calculus, Data Structures and Programming

INTENDED AUDIENCE : Computer Science and Engineering, Electronics Engineering, Electrical Engineering

COURSE OUTLINE :

The course will have a comprehensive coverage of theory and computation related to imaging geometry, and scene understanding. It will also provide exposure to clustering, classification and deep learning techniques applied in this area.

ABOUT INSTRUCTOR :

Prof. Jayanta Mukhopadhyay, Professor in Computer Science and Engineering, IIT Kharagpur, and engaged in teaching and research in this area for about 30 years.

COURSE PLAN :

Week 1: Fundamentals of Image Processing

Week 2: 2-D Projective Geometry and Homography and Properties of homography

Week 3: Camera geometry

Week 4: Stereo geometry

Week 5: Stereo Geometry

Week 6: Feature detection and description

Week 7: Feature matching and model fitting

Week 8: Color Processing

Week 9: Range image processing

Week 10: Clustering and classification

Week 11: Dimensionality Reduction and Sparse Representation

Week 12: Deep Neural Architecture and applications



COMPUTER VISION AND IMAGE PROCESSING - FUNDAMENTALS AND APPLICATIONS

PROF. M.K. BHUYAN

Department of Electrical Engineering
IIT Guwahati

PRE-REQUISITES : Basic co-ordinate geometry, matrix algebra, linear algebra and random process.

INTENDED AUDIENCE : UG, PG and Ph.D students

INDUSTRIES APPLICABLE TO : The software industries that develop computer visions apps would be benefitted from this course.

COURSE OUTLINE :

The intent of this course is to familiarize the students to explain the fundamental concepts/issues of Computer Vision and Image Processing, and major approaches that address them. This course provides an introduction to computer vision including image acquisition and image formation models, radiometric models of image formation, image formation in the camera, image processing concepts, concept of feature extraction and selection for pattern classification/recognition, and advanced concepts like motion estimation and tracking, image classification, scene understanding, object classification and tracking, image fusion, and image registration, etc.

This course will cover the fundamentals of Computer Vision. It is suited for mainly students who are interested in doing research in the area of Computer Vision. After completing the course, the students may expect to have the knowledge needed to read and understand more advanced topics and current research literature, and the ability to start working in industry or in academic research in the field of Computer Vision and Image Processing. They can also apply all these concepts for solving the real-world problems.

ABOUT INSTRUCTOR :

Prof. Manas Kamal Bhuyan received a Ph.D. degree in electronics and communication engineering from the India Institute of Technology (IIT) Guwahati, India. He was with the School of Information Technology and Electrical Engineering, University of Queensland, St. Lucia, QLD, Australia, where he was involved in postdoctoral research. Subsequently, he was a Researcher with the SAFE Sensor Research Group, NICTA, Brisbane, QLD, Australia. He was an Assistant Professor with the Department of Electrical Engineering, IIT Roorkee, India and Jorhat Engineering College, Assam, India. In 2014, he was a Visiting Professor with Indiana University and Purdue University, Indiana, USA. Dr. Bhuyan was a recipient of the National Award for Best Applied Research/ Technological Innovation, which was presented by the Honorable President of India, the Prestigious Fulbright-Nehru Academic and Professional Excellence Fellowship, and the BOYSCAST Fellowship. He is an IEEE senior member. He is currently a Professor with the Department of Electronics and Electrical Engineering, IIT Guwahati, and Associate Dean of Infrastructure, Planning and Management, IIT Guwahati. His current research interests include image/video processing, computer vision, machine learning and human computer interactions (HCI), virtual reality and augmented reality. He has almost 25 years of industry, teaching, and research experience. He is the author of the book text book "Computer Vision and Image Processing: Fundamentals and Applications". For more details www.iitg.ac.in/mkb

COURSE PLAN :

Week 1: Introduction to Computer Vision and Basic Concepts of Image Formation: Introduction and Goals of Computer Vision and Image Processing, Image Formation Concepts.

Week 2: Fundamental Concepts of Image Formation: Radiometry, Geometric Transformations, Geometric Camera Models.

Week 3: Fundamental Concepts of Image Formation: Camera Calibration, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projections.

Week 4: Image Processing Concepts: Image Transforms.

Week 5: Image Processing Concepts: Image Transforms, Image Enhancement.

Week 6: Image Processing Concepts: Image Filtering, Colour Image Processing, Image Segmentation

Week 7: Image Descriptors and Features: Texture Descriptors, Colour Features, Edges/Boundaries.

Week 8: Image Descriptors and Features: Object Boundary and Shape Representations.

Week 9: Image Descriptors and Features: Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency

Week 10: Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.

Week 11: Applications of Computer Vision: Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, Autoencoders.

Week 12: Applications of Computer Vision: Gesture Recognition, Motion Estimation and Object Tracking, Programming Assignments.



DATA ANALYTICS WITH PYTHON

PROF. A RAMESH

Department of Management Studies
IIT Roorkee

INTENDED AUDIENCE : Management, Industrial Engineering and Computer Science Engineering Students

INDUSTRIES APPLICABLE TO : Any analytics company

COURSE OUTLINE :

We are looking forward to sharing many exciting stories and examples of analytics with all of you using python programming language. This course includes examples of analytics in a wide variety of industries, and we hope that students will learn how you can use analytics in their career and life. One of the most important aspects of this course is that you, the student, are getting hands-on experience creating analytics models; we, the course team, urge you to participate in the discussion forums and to use all the tools available to you while you are in the course!

ABOUT INSTRUCTOR :

Prof. Ramesh Anbanandam graduated in Production Engineering from Madras University, Chennai. He did his post-graduation from National Institute of Technology, Trichy. He later earned his Ph.D. in Supply Chain Management from Indian Institute of Technology Delhi. His professional interest includes Humanitarian Supply Chain Management, Operations Management, Operations Research, Healthcare Waste Management, Sustainable Multi-model and Freight Transportation, Transportation Asset Management and Advanced Data Analytics using Python and R-programming. He has published various research articles in reputed journals. He was also awarded Emerald Literati Award for Excellence under "Highly Commended Research Paper in the Year 2011 and 2016" in the field of Supply Chain Management.

COURSE PLAN :

Week 1: Introduction to data analytics and Python fundamentals

Week 2: Introduction to probability

Week 3: Sampling and sampling distributions

Week 4: Hypothesis testing

Week 5: Two sample testing and introduction to ANOVA

Week 6: Two way ANOVA and linear regression

Week 7: Linear regression and multiple regression

Week 8: Concepts of MLE and Logistic regression

Week 9: ROC and Regression Analysis Model Building

Week 10: χ^2 Test and introduction to cluster analysis

Week 11: Clustering analysis

Week 12: Classification and Regression Trees (CART)



DATA BASE MANAGEMENT SYSTEM

PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SAMIRAN CHATTOPADHYAY

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Procedural and / or Object-Oriented Programming (C / C++ / Java / Python), Data Structures, Algorithms

INTENDED AUDIENCE : Students from all disciplines can enroll for this course.

INDUSTRIES APPLICABLE TO : DBMS is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems, data mining, machine learning) have a need for the same. These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

COURSE OUTLINE :

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. Consequently, Oracle, Microsoft SQL Server, Sybase etc. have emerged as leading commercial systems while MySQL, PostgreSQL etc. lead in open source and free domain.

While DBMS's differ in the details, they share a common set of models, design paradigms and a Structured Query Language (SQL). In this background the course examines data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation. More specifically, the course introduces relational data models; entity-relationship modeling, SQL, data normalization, and database design. Further it introduces query coding practices using MySQL (or any other open system) through various assignments. Design of simple multi-tier client / server architectures based and Web-based database applications is also introduced.

ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Prof. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (<https://www.facebook.com/t10kt.algorithms/>) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

Prof. Samiran Chattopadhyay obtained his B Tech and M Tech degree in 1987 and 1989 respectively from IIT Kharagpur. He obtained his PhD degree from Jadavpur University in 1993. He served as a faculty in the Department of Computer Science and Engineering, Jadavpur University from 1989 to 1993. In 1993, he moved to industry and joined back the same department in Jadavpur University as an Associate Professor in 1997. Since 2001, he is a Professor of Information Technology in Jadavpur University.

Prof. Chattopadhyay is also a visiting fellow of the University of Northumbria, Newcastle upon Tyne UK. He was an adjunct faculty at IIT Kharagpur for the Distributed Systems course and a visiting faculty member for the MTech course by IIT Kharagpur which was offered in distance learning mode.

Dr. Chattopadhyay has more than two decades of experience of serving reputed Industry houses including Mindware, Computer Associates TCG Software, Interra Systems India Ltd. He is also a project consultant of the prestigious National Digital Library Mission of Government of India.

Prof. Chattopadhyay has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Ad hoc Wireless Networks, Cloud Computing. Dr. Chattopadhyay has been a co-faculty in Database Management Systems in NPTEL-NOC.

Prof. Chattopadhyay has published over 60 technical papers in international journals in the areas of Wireless Networks, Network Security, Machine learning applications. He has co-authored a research monograph titled 'Digital Geometry in Image Processing', a textbook titled 'Data Structures through C' and 'Big Data in e-Healthcare'. His current research interests include Network Security, Machine learning, Wireless network and Pervasive computing.

COURSE PLAN :

Week 1: Course Overview, Introduction to RDBMS

Week 2: Structured Query Language (SQL)

Week 3: Relational Algebra, Entity-Relationship Model

Week 4: Relational Database Design

Week 5: Application Development, Case Studies, Storage and File Structure

Week 6: Indexing and Hashing, Query Processing

Week 7: Query Optimization, Transactions (Serializability and Recoverability)

Week 8: Concurrency Control, Recovery Systems, Course Summarization



DATA STRUCTURE AND ALGORITHMS USING JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++/Java, data structures and algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines, namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. For developing large software, software developers should have enough proficiency of data structures and algorithms. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of data structures and algorithms and how the same can be implemented using Java programming language. The participants of the proposed course will be able to improve their skills, to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Dr. Samanta currently works as a faculty member at the Department of Computer Science & Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: 1D array, list and vector, 2D matrices and tables of objects

Week 2: Java implementation of 1D and 2D arrays and its operations

Week 3: Linked lists and its various operations, stack and queue

Week 4: Java implementation of linked lists, stack and queue

Week 5: Binary trees: Representation and operations. Variations of binary tree: Binary search tree, Height balanced search tree, Heap tree

Week 6: Java implementation of binary trees and its variations

Week 7: Graph : Structure, representation and operations

Week 8: Java implementations of graph data structures

Week 9: Algorithms (Part-I): Searching and sorting algorithms

Week 10: Java implementation of Part-I algorithms

Week 11: Algorithms (Part-II): Greedy algorithms, shortest path algorithms

Week 12: Java implementation of Part-II algorithms



Deep learning - IIT Ropar

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

PROF. PADMAVATI

Punjab Engineering College (Deemed To Be University)
Department of Computer Science & Engineering

INTENDED AUDIENCE: Any Interested Learners

PRE-REQUISITES : Working knowledge of Linear Algebra, Probability Theory. It would be beneficial if the participants have done a course on Machine Learning.

COURSE OUTLINE :

Deep Learning has received a lot of attention over the past few years and has been employed successfully by companies like Google, Microsoft, IBM, Facebook, Twitter etc. to solve a wide range of problems in Computer Vision and Natural Language Processing. In this course we will learn about the building blocks used in these Deep Learning based solutions. Specifically, we will learn about feedforward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms. We will also look at various optimization algorithms such as Gradient Descent, Nesterov Accelerated Gradient Descent, Adam, AdaGrad and RMSProp which are used for training such deep neural networks. At the end of this course students would have knowledge of deep architectures used for solving various Vision and NLP tasks

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

Prof. Padmavati received B.E degree in Computer Science & Engineering with distinction from PDACE, Gulbarga, V.T.U, Belgaum, Karnataka, M.E. degree in Computer Science & Engineering and Ph.D from Punjab Engineering College (Deemed to be University), Chandigarh. Currently, she is working as Assistant Professor at Punjab Engineering College (Deemed to be University), Chandigarh, India. She has been teaching this course since two years for M.Tech students. She has also offered courses like Data structure, Analysis and design of algorithms, Object oriented programming, Research methodology, and Wireless sensor networks. Her research interests are in the areas of Wireless sensor networks, IoT, machine learning and deep learning. Her current research projects include "Classification of Parkinson's disease using machine learning algorithms", "Major depressive disorder using EEG Signal", and "Detection of neurological disorder - Epilepsy using EEG Signals".

COURSE PLAN :

Week 1: History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron

Week 2: Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent

Week 3: Feed Forward Neural Networks, Back propagation

Week 4: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD

Week 5: Principal Component Analysis and its interpretations, Singular Value Decomposition

Week 6: Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders

Week 7: Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation

Week 8: Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

Week 9: Learning Vectorial Representations Of Words

Week 10: Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet

Week 11: Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Week 12: Encoder Decoder Models, Attention Mechanism, Attention over images



DESIGN AND ANALYSIS OF ALGORITHMS

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE: Students in BE/BTech Computer Science, 2nd/3rd year.

PRE-REQUISITES: Exposure to introductory courses on programming and data structures.

INDUSTRY SUPPORT: This course should be of value to any company working in the area of software services and products.

COURSE OUTLINE:

This course will cover basic concepts in the design and analysis of algorithms.

- Asymptotic complexity, $O()$ notation
- Sorting and search
- Algorithms on graphs: exploration, connectivity, shortest paths, directed acyclic graphs, spanning trees
- Design techniques: divide and conquer, greedy, dynamic programming
- Data structures: heaps, union of disjoint sets, search trees
- Intractability

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD.

COURSE PLAN:

Week 1:

Module 1: Introduction

Module 2: Examples and motivation

Module 3: Examples and motivation

Module 4: Asymptotic complexity: informal concepts

Module 5: Asymptotic complexity: formal notation

Module 6: Asymptotic complexity: examples

Assignments MCQ/Fill in blanks (unique answer)

Week 2

Module 1: Searching in list: binary search

Module 2: Sorting: insertion sort

Module 3: Sorting: selection sort

Module 4: Sorting: merge sort

Module 5: Sorting: quicksort

Module 6: Sorting: stability and other issues

Assignments MCQ/Fill in blanks, programming assignment

Week 3

Module 1: Graphs: Motivation

Module 2: Graph exploration: BFS

Module 3: Graph exploration: DFS

Module 4: DFS numbering and applications

Module 5: Directed acyclic graphs

Module 6: Directed acyclic graphs

Assignments MCQ/Fill in blanks, programming assignment

Week 4

Module 1: Shortest paths: unweighted and weighted

Module 2: Single source shortest paths: Dijkstra

Module 3: Single source shortest paths: Dijkstra

Module 4: Minimum cost spanning trees: Prim's algorithm

Module 5: Minimum cost spanning trees: Kruskal's Algorithm

Module 6: Union-Find data structure

Assignments MCQ/Fill in blanks, programming assignment

Week 5

Module 1: Divide and conquer: counting inversions

Module 2: Divide and conquer: nearest pair of points

Module 3: Priority queues, heaps

Module 4: Priority queues, heaps

Module 5: Dijkstra/Prims revisited using heaps

Module 6: Search Trees: Introduction

Assignments MCQ/Fill in blanks, programming assignment

Week 6

Module 1: Search Trees: Traversals, insertions, deletions

Module 2: Search Trees: Balancing

Module 3: Greedy : Interval scheduling

Module 4: Greedy : Proof strategies

Module 5: Greedy : Huffman coding

Module 6: Dynamic Programming: weighted interval scheduling

Assignments MCQ/Fill in blanks, programming assignment

Week 7

Module 1: Dynamic Programming: memoization

Module 2: Dynamic Programming: edit distance

Module 3: Dynamic Programming: longest ascending subsequence

Module 4: Dynamic Programming: matrix multiplication

Module 5: Dynamic Programming: shortest paths: Bellman Ford

Module 6: Dynamic Programming: shortest paths: Floyd Warshall

Assignments MCQ/Fill in blanks, programming assignment

Week 8

Module 1: Intractability: NP completeness

Module 2: Intractability: reductions

Module 3: Intractability: examples

Module 4: Intractability: more examples

Module 5: Misc topics

Module 6: Misc topics

Assignments MCQ/Fill in blanks



DESIGN OF POWER ELECTRONIC CONVERTERS

PROF. SHABARI NATH

Department of Electronics and Electrical Engineering
IIT Guwahati

PRE-REQUISITES : Introductory course on power electronics.

INTENDED AUDIENCE : People with interest in power electronics, especially hardware design.

INDUSTRIES APPLICABLE TO : Companies involved in power electronics product designing and its applications

COURSE OUTLINE :

Undergraduate level courses on power electronics teach different power converter circuits and methods to analyze them. But all jobs related to power electronics need good knowledge of designing hardware. Proper hardware design in power electronics involves knowledge of several topics which are beyond the scope of a core course in power electronics. This course intends to fill this gap.

In this course, students will learn the important concepts needed to design proper power electronic hardware, simulation tools, proper designing of power PCB, designing magnetics, reducing electromagnetic interference etc. By the end of course students should be able to design and test any power electronic converter on their own.

ABOUT INSTRUCTOR :

Prof. Shabari Nath is an Associate Professor in the Department of Electronics and Electrical Engineering, Indian Institute of Technology Guwahati, Assam, India, since 2021. She was Assistant Professor in the same institute from 2014 to 2021. Prior to that, she was a Product Design Engineer with Cummins, Inc., USA, for two years. She completed the B.E. degree in electrical engineering from Jabalpur Engineering College, Jabalpur, India, in 2005, the M.Tech. degree in electrical engineering from the Indian Institute of Technology Bombay, Mumbai, India, in 2008, and the Ph.D. degree from the University of Minnesota, Minneapolis, MN, USA, in 2012. Her research interests include multiport converters, solid state transformers, power electronic converters for power systems, renewable energy systems, charging of electric vehicles and smart microgrids.

COURSE PLAN :

Week 1: Analysis of power electronic converters

Week 2: Power semiconductor devices

Week 3: Gate drivers

Week 4: Snubber design

Week 5: Thermal Design

Week 6: Magnetics Design

Week 7: Electromagnetic interference in power electronic converters

Week 8: Familiarity and design on power electronic hardware



DESIGN, TECHNOLOGY AND INNOVATION

PROF. B.K.CHAKRAVARTHY

Department of Design Engineering
IIT Bombay

INTENDED AUDIENCE : Open for all

COURSE OUTLINE :

The course on Design Technology and Innovation portrays innovation as it weaves together a multitude of domains like design, technology, humanities and management. Through the span of 8 weeks, we have professors from various departments who will narrate their stories of how they took their research to innovation for the benefit of the community at large. The initial lectures focus on establishing the methodology of innovation by showcasing the collaborative model of innovation and the Chakku's 7 Concerns which forms the backbone of the innovation process. As the professors walk you through their innovation success stories, you will be able to learn and understand the pitfalls of innovation and the stages of transformation of research into innovation. Through these case studies, you will not only learn the stages of the innovation, but also learn to collaborate with different people of different disciplines. The passion with which the professors go beyond their routine to innovate will inspire you to take up innovation in your areas of work.

ABOUT INSTRUCTOR :

Prof. B. K. Chakravarthy teaches Innovation by Design at the Industrial Design Centre (IDC), IIT Bombay. He has set up the Shenoy Innovation Studio at IITB, where students and young designers are given the opportunity to work on live projects and benefit from expertise in a range of interrelated fields. Prof. Chakravarthy works closely with other academics engaged in cutting-edge research at IIT Bombay and has played a key role in translating such research into products that reach the hands of users. A Collaborative Model for New Product Innovation, an outcome of Prof. Chakravarthy's doctoral research, has had wide application in the industry. Prof. Chakravarthy has also worked frequently with government departments and occupational communities engaged in essential services.

COURSE PLAN :

Week 1 : i. Jaipur Foot - A classic innovation by Prof. B. K. Chakravarthy

ii. User Centred Helmet Design by Prof. B. K. Chakravarthy

Week 2 : Challenges of Reaching a Million Users by Prof. Chetan Solanki and Prof Jayendran V

Week 3 : i. Technology to Solution by Prof. Ramesh Singh

ii. Collaborative Excellence by Prof. B. Ravi & Prof. B. K. Chakravarthy

Week 4 : Collaborative Innovation Methods by Prof B. K. Chakravarthy

Week 5 : Learnings from Grassroot Innovation by Prof. Anil Gupta

Week 6 : Systemic Approach to Biomed Innovations by Prof. B. Ravi

Week 7 : Research to Innovation by Prof. Amaresh Chakrabarti

Week 8 : Smartcane for the Blind- A Success Story by Prof. P. V. Madhusudhan Rao



DIGITAL DESIGN WITH VERILOG

PROF. CHANDAN KARFA

Department of Computer Science & Engineering
IIT Guwahati

PROF. ARYABARTTA SAHU

Department of Computer Science & Engineering
IIT Guwahati

PRE-REQUISITES : Basic Electronics

INTENDED AUDIENCE : BTech in CSE, ECE, EIE, MnC second year students

INDUSTRY SUPPORT : VLSI Industries like Intel, Qualcomm, Samsung, Apple, Xilinx, etc.

COURSE OUTLINE :

Digital Design is a fundamental course for developing large VLSI designs. This course helps student to understand the internal logic of various combinational units that is needed to develop large VLSI design. The course also introduces the sequential components, clocks and concepts of register transfer level design development process. In this course, we not only introduce the core concepts of digital design, we also introduce hardware description language Verilog. In each module, we will discuss how to implement all fundamental blocks in Verilog. Therefore, this course will help students to understand the internal details of fundamental blocks of digital circuits and also their implementation details.

ABOUT INSTRUCTOR :

Prof. Chandan Karfa is an Associate Professor in the Dept. of CSE, IIT Guwahati. He has worked for five years as Senior R&D engineer in EDA Industry in the domain of High-level Synthesis and Logic Synthesis. He has worked as visiting researcher at New York University, May - July 2019. He has also more than six years teaching experiences. He has taught Digital Design course in IIT Guwahati three times. His research interests include High-level Synthesis, CAD for VLSI, Hardware Security and Formal Verification.

Prof. Aryabartta Sahu is an Associate Professor in the Dept. of CSE, IIT Guwahati. He has 12 years of teaching experience at IIT Guwahati in the domain of Digital Design, Computer Architecture, Digital System Laboratory with FPGA, and High Performance Computing. He has taught Digital Design course five times and Digital System Lab five times at IIT Guwahati times. His research interests include FPGA Design, Embedded System Design and Testing, High Performance Computing.

COURSE PLAN :

Week 1: Introduction to Digital Design and Switching Algebra

Lecture 1: Introduction to Digital Design

Lecture 2: Switching Algebra

Lecture 3: Number Systems

Week 2: Number Systems and Binary Codes

Lecture 4: Number Systems: Conversion of Bases

Lecture 5: Number Systems: Sign representation,

Lecture 6: 2's complement addition

Lecture 7: Binary Codes

Week 3: Minimization of Switching functions

Lecture 8: Minimization of Boolean functions: Karnaugh Map

Lecture 9: Prime Implicants and Essential Prime Implicants

Lecture 10: Tabulation method

Lecture 11: Prime implicant chart and its reduction, Branching method

Week 4: Multi-level Logic Optimization Heuristic Based Logic

Lecture 12: ESPRESSO: Heuristic-based Logic Optimization

Lecture 13: Prime Implicants and Essential Prime Implicants

Lecture 14: Multi-level Logic Minimization using Prime Implication Chart

Week 5: Introduction to Verilog

Lecture 15: Verilog(Cont)

Lecture 16: Verilog(Cont)

Lecture 17: Verilog

Week 6: Combinational Logic Design: Part 1

Lecture 18: Code Conversion, Parity Checker, Comparator
Lecture 19: Multiplexer, Decoder Decimal Decoder,
Lecture 20: Full-Adder, Ripple Carry Adder

Week 7: Combinational Logic Design: Part 2

Lecture 21: Carry Look ahead adder
Lecture 22: Sign adder, Add/Sub,
Lecture 23: BCD Adder, Multiplier
Lecture 24: Combinational Design using Verilog
Lecture 25: Combinational Design using Verilog

Week 8:

Lecture 26: Sequential Design: Flipflop
Lecture 27: Sequential Design: Counter,
Lecture 28: Sequential Design: Register

Week 9:

Lecture 29: Implementation of FLipflop,
Lecture 30: counters and registers in Verilog
Lecture 31: Finite State Machine Modeling Sequential Design with FSM
Lecture 32: Implementation Methodologies for FSM FSM Minimization

Week 10:

Lecture 33: Implementation of FSM using Verilog
Lecture 34: Implementation of FSM using Verilog
Lecture 35: Implementation of FSM using Verilog
Lecture 36: Testing of FSM

Week 11:

Lecture 37: Algorithmic State Machine and RTL
Lecture 38: Implementation Methodologies for ASM
Lecture 39: RTL design of Sequential Multiplier using ASM/RTL

Week 12:

Lecture 40: RTL Design using Verilog(Cont)
Lecture 41: RTL Design using Verilog(Cont)
Lecture 42: RTL Design using Verilog



DRUG DELIVERY: PRINCIPLES AND ENGINEERING

PROF. RACHIT AGARWAL

Department of BioSystems Science and Engineering

IISc Bangalore

INTENDED AUDIENCE : Anyone in bachelors having completed two year

PREREQUISITES : A course in biochemistry, molecular biology, anatomy is recommended

INDUSTRY SUPPORT : All pharmaceuticals, hospitals and biotechnology industries

COURSE OUTLINE :

This course introduces concepts of drug delivery to meet medical challenges. The course is designed to be modular, with each module focusing on the various aspects of drug delivery.

ABOUT INSTRUCTOR :

Rachit Agarwal is an associate professor at the Indian Institute of Science, Bangalore, India. He did his undergraduate studies at the Indian Institute of Technology, Kharagpur, India in Biotechnology. Rachit then worked in the field of biomaterial-based drug delivery for his PhD. at the University of Texas at Austin, Texas, USA. His post-doctoral fellowship was in regenerative medicine at the Georgia Institute of Technology, Atlanta, USA. His scientific interests are in developing biomaterial-based delivery vehicles for the treatment of inflammatory and infectious diseases. He is a recipient of the prestigious Ramanujan fellowship, Har-Gobind Khorana Young Biotechnologist award, and DBT/Wellcome Trust India Alliance Intermediate Fellowship. He is also the early career editorial board member for the Journal of Biomedical Materials Research Part A (JBMR-A). Two major areas of interest are in the treatment of Osteoarthritis and using inhalable biomaterials for the prevention and treatment of lung infections to translate science into technologies that can be used in the clinic. More information at <https://be.iisc.ac.in/~rachit/>

COURSE PLAN :

Week 1 :Pharmacokinetics: Bioavailability, Elimination, Therapeutic index

Week 2 :Prodrugs, Controlled release

Week 3 :Polymers: Synthesis, properties, characterization, crystallinity and amorphousness

Week 4 :Biopolymers: Natural and Synthetic, biocompatibility, Biodegradation, commonly used biopolymers

Week 5 :Polymer-Drug conjugates, PEGylation

Week 6 :Diffusion controlled systems, Ficks laws, Reservoir systems, Non-erodible matrix systems, Bio-erodible Systems

Week 7 :Hydrogels: Physical or chemical, pore-size calculation, in-situ crosslinking

Week 8 :Nano and Micro-particles: Dendrimers, Liposomes, Micelles

Week 9 :Metal and polymeric particles, effect of particle shape, charge and elasticity

Week 10 :Protein Adsorption and tissue engineering, Drug delivery in tissue engineering

Week 11 :Implant associated infections, Route specific delivery: Oral, Subcutaneous, Intramuscular, transdermal, inhalation, intravenous

Week 12 :Vaccines, Cancer vaccines, Cell and gene delivery, Smart responsive drug delivery, Targeted drug delivery, Nanotoxicology and market translation



EDGE COMPUTING

PROF. RAJIV MISRA

Department of Computer Science & Engineering
Indian Institute of Technology Patna

PRE-REQUISITES : Networking

INTENDED AUDIENCE : CSE, ECE, EE

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE :

This course we will cover fundamentals of Edge computing and its applications in low latency and critical real-time computing scenarios. The course brings in theory of Edge computing, focusing on it as a complementary approach that addresses some of the limitations of cloud computing. The course will cover applications where edge computing is a necessity, such as real-time applications that require low latency and high bandwidth. For example, autonomous vehicles require real-time processing of data from sensors, which cannot be done in a centralized data center due to latency issues. This course covers various innovations of waves from cloud computing to edge computing. This course provides an in-depth understanding of edge computing principles with different use case of edge computing. In this course we will explore different frameworks for computing over edge devices and cloud. We will cover different techniques for distributed data analytics over edge devices like edge data center. Different edge computing fundamentals will be covered, such as RTT, Docker containers, Kubernetes, MQTT, Kafka, time and clock synchronization and key-value stores at edge. We will also cover various cloud platforms that provide edge services. This course also covers recent advances of machine learning, deep learning and artificial intelligence with appropriate use cases in edge computing such as predictive maintenance, self driving cars and deep reinforcement learning for edge applications.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is an Associate Professor in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelor's of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned Distributed Systems, Cloud Computing, Big Data Computing, Consensus in Blockchain, Cloud IoT Edge Computing, Adhoc Networks and Sensor Networks. He has contributed significantly to these areas and published more than 70 papers in high quality journals and conferences, and 2 book chapters. His h-index is 11 with more than 700 citations. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, IEEE Systems Journal, Adhoc Networks, Computer Network, Journal of Parallel and Distributed Computing. He has edited a book titled as "Smart Techniques for a Smarter Planet: Towards Smarter Algorithms" for the "Studies in Fuzziness and Soft Computing" book series, Springer (2019). He has supervised four Phd students and currently Six Phd students working under his supervision in the area of Distributed Systems, Cloud Computing, Big Data Computing, Consensus in Blockchain, Cloud IoT Edge Computing, and 5G. He is a senior member of the IEEE and fellow of IETE. He has completed as the Principal Investigator of R&D Project Sponsored by DeITY entitled as "Vehicular Sensor and Mesh Networks based Future ITS". He has mentored the online courses on Big Data Computing, Cloud Computing, Advanced Graph Theory and Distributed Systems in the platform of NPTEL.

COURSE PLAN :

- Week 1 :** Introduction to Cloud and its limitations to support low latency and RTT. From Cloud to Edge computing: Waves of innovation
- Week 2 :** Introduction to Edge Computing Architectures
- Week 3 :** Edge Computing to support User Applications (5G-Slicing, self-driving cars and more)
- Week 4 :** Concepts of distributed systems in edge computing such as time ordering and clock synchronization, distributed snapshot, etc.
- Week 5 :** Introduction to Edge Data Center, Lightweight Edge Clouds and its services provided by different service providers.
- Week 6 :** Introduction to docker container and Kubernetes in edge computing. Design of edge storage systems like key-value stores
- Week 7 :** Introduction to MQTT and Kafka for end-to-end edge pipeline. Edge analytics topologies for M2M and WSN network (MQTT)
- Week 8 :** Use cases of machine learning for edge sensor data in predictive maintenance, image classifier and self-driving cars. Deep Learning On-Device inference at the edge to support latency-based application



EMBEDDED SENSING, ACTUATION AND INTERFACING SYSTEMS

PROF. BANIBRATA MUKHERJEE

Department of Electrical and Electronics Engineering
IIT Kharagpur

PRE-REQUISITES : Basic electrical circuit related courses covered till B.E/B.Tech 2nd or 3rd year with background of Electrical/Electronics/Instrumentation/Mechatronics or allied disciplines.

INTENDED AUDIENCE : PG; UG third year or final year; Ph.D students; Faculty from Engineering colleges; Working Professional from Industry.

INDUSTRY WHO MAY BE INTERESTED: Analog Devices, Texas Instruments, Honeywell, Danfoss etc. and Start-ups related to sensor, actuator and interfacing circuit development.

COURSE OUTLINE :

Sensors and actuators are the integral parts of an embedded control system which finds versatile applications in automobile, aerospace, biomedical, consumer electronics, agriculture, industry 4.0 and so on. Sensors and actuators connect the analog real world with the embedded controller through dedicated hardware interfacing circuits. This course is aimed at developing practical technical skills among the students to integrate various sensing, actuation units and other required accessories with embedded controller and build a complete modern embedded control system for intended applications. This will further enable the students to gather necessary concepts to develop and select suitable smart sensors, actuators, with associated knowledge of interface electronics and signal conditioning for cutting-edge applications. Further, micromachining technology for miniaturization of smart integrated MEMS devices and renewable energy harvesting based self-powered embedded system implementation are other important attributes of this course.

ABOUT INSTRUCTOR :

Prof. Banibrata Mukherjee is currently working as an Assistant Professor in Advanced Technology Development Centre (ATDC) at IIT Kharagpur since June 2019. Prior to joining IIT Kharagpur, he served as an Assistant Professor in Department of Electronics and Communication Engineering at NIT Rourkela for more than 3 years. Regarding his academic background, he received B.E degree in Instrumentation and Electronics from Jadavpur University in 2009 and M.Tech in Instrumentation and Ph.D degree both from Department of Electrical Engineering at IIT Kharagpur in 2011 and 2016 respectively. He is a Senior member of IEEE, and recipient of Early Career Research Award from Science and Engineering Research Board (SERB). His primary research interests include sensors and interfacing circuits; energy harvester and power management circuit; MEMS devices; sensor fusion, embedded system and biomedical instrumentation. He has several publications in various reputed Journals and Conferences. He has been actively working on various sponsored projects in the area of hybrid energy harvester, self-powered MEMS sensor system, sensor fusion based navigation system etc.

COURSE PLAN :

Week 1:

Introduction:

Overview of embedded system; Importance of sensors, actuators and interfacing circuits in embedded control system; Characteristics; Applications.

Week 2:

Embedded Sensors and Actuators:

Various types of important sensors, actuators and their working principles: e.g, thermal, mechanical, electrical, magnetic, optical, smart material and meta material based.

Week 3:

Interfacing Aspects of Sensors and Actuators to Embedded Controller and their Communication Protocols:

Signal conditioning circuits; Op-Amp based interfacing circuit implementation; Various Serial Communication protocols for interfacing.

Week 4:

Advancement in Interfacing Schemes of Resistive Sensors for Linearity Improvement and Error Reduction:

Resistive sensor examples; Non-idealities in basic interfacing circuits; Linearization techniques; Error reduction schemes due to environmental effects and remote communication.

Week 5:

Advanced Techniques for Direct Interfacing of Resistive Sensors with Embedded controller:

Embedded controller based excitation system; Direct interfacing schemes of various resistive sensors topologies to microcontrollers; Interfacing scheme for sensor array.

Week 6:

Advanced Techniques for Direct Interfacing of Capacitive Sensors with Embedded Controller:

Capacitive sensor examples; Interfacing scheme for different capacitive sensor configurations; Direct interfacing schemes.

Week 7:

Advancement in Design of Interfacing Circuits for Lossy Capacitive Sensors:

Lossy Capacitive sensor characteristics; Various advanced interfacing schemes for lossy capacitive sensor.

Week 8:

Miniaturized Smart Sensors and Actuators:

Miniaturized device fabrication technology; Various types of important MEMS sensors and actuators, their design and operation.

Week 9:

Interfacing electronics for miniaturized sensors and actuators:

Integration techniques; System-on-Chip integration for various MEMS sensors and actuators; Applications.

Week 10:

Renewable Energy Harvesters to Develop Self-Powered Embedded System:

Various energy harvesting techniques; Interfacing power management circuits; Recent trends towards development of self-powered smart system

Week 11:

Application Case Studies of Embedded Sensing, Actuation and Interfacing System in Automotives Domain

Week 12:

Application Case Studies of Embedded Sensing, Actuation and Interfacing System in Healthcare Domain



EMBEDDED SYSTEMS DESIGN

PROF. ANUPAM BASU

Department of Computer Science & Engineering
IIT Kharagpur

PRE-REQUISITES : Computer Organization, Basic of Microprocessors

INTENDED AUDIENCE : Environmental engineering professionals and students pursuing a degree with emphasis in Environmental engineering.

INDUSTRIES APPLICABLE TO : Any industry working in the area of Embedded Systems

COURSE OUTLINE :

This course on Embedded systems will first the students to the fundamental requirements of embedded systems and the interaction between hardware and software in such systems. Next the course will discuss some basic steps of hardware design, introduce the students to ASIPs, ASICs and FPGAs. Next, the students will be exposed to the very important issue of designing for less power consumption and introduce them to the techniques that are adopted to this end. Since many of the embedded systems will have real time constraints, basic issues of real time operating systems will be discussed. This will be followed by formal specification models and languages, mapping the specification to hardware and software components along with decisions on design tradeoffs and hardware software partitioning. Next, synthesis of hardware and software along with a few of the optimization techniques will be presented. The course will end with a brief overview of design verification methods that are adopted for embedded system design.

ABOUT INSTRUCTOR :

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN :

- Week 1:** Introduction to Embedded System, ASICs and ASIPs
- Week 2:** Designing Single Purpose Processors and Optimization
- Week 3:** Introduction to FPGAs and Synthesis
- Week 4:** Verilog Hardware Description Language (Verilog HDL)
- Week 5:** Microcontrollers and Power Aware Embedded System Design
- Week 6:** Real Time Operating System
- Week 7:** Real Time Scheduling Algorithms
- Week 8:** Modelling and Specification
- Week 9:** Design Synthesis
- Week 10:** Digital Camera Design and Hardware Software Partitioning
- Week 11:** Design Optimization
- Week 12:** Simulation and Verification



ENHANCING SOFT SKILLS AND PERSONALITY

PROF.T. RAVICHANDRAN

Department of Humanities and Social Sciences
IIT Kanpur

INTENDED AUDIENCE : Students, Teachers, Professionals, Trainers, Leaders, Employers

INDUSTRIES APPLICABLE TO : All industry/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

COURSE OUTLINE :

The course aims to cause an enhanced awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfilment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The focus of this course is on interpersonal and management skills. It has been approved for "Faculty Development Programme" by AICTE.

ABOUT INSTRUCTOR :

Prof. T. Ravichandran is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad.

COURSE PLAN :

Week 1 : Highlights of Developing Soft Skills and Personality Course-1-24 ; Highlights of Developing Soft Skills and Personality Course-25-48 ; Definitions and Types of Mindset ; Learning Mindsets ; Secrets of Developing Growth Mindsets

Week 2 : Importance of Time and Understanding Perceptions of Time ; Using Time Efficiently ; Understanding Procrastination ; Overcoming Procrastination ; Don't Say "Yes" to Make Others Happy!

Week 3 : Types of People ; How to Say "No" ; Controlling Anger ; Gaining Power from Positive Thinking-1 ; Gaining Power from Positive Thinking-2

Week 4 : What Makes Others Dislike You? ; What Makes Others Like You?-1 ; What Makes Others Like You?-2 ; Being Attractive-1 ; Being Attractive-2

Week 5 : Common Errors-1 ; Common Errors-2 ; Common Errors-3 ; Common Errors-4 ; Common Errors-5

Week 6 : Humour in Communication ; Humour in the Workplace ; Function of Humour in the Workplace ; Money and Personality ; Managing Money

Week 7 : Health and Personality ; Managing Health-1: Importance of Exercise ; Managing Health-2: Diet and Sleep ; Love and Personality ; Managing Love

Week 8 : Ethics and Etiquette ; Business Etiquette ; Managing Mind and Memory ; Improving Memory ; Care for Environment ; Highlights of the Course



ENTREPRENEURSHIP

PROF. C BHAKTAVATSALA RAO

Department of Management Studies
IIT Madras

PRE-REQUISITES : No special pre-requisites except that must preferably in the Third or Fourth Year of UG

INTENDED AUDIENCE : Newly graduating UG and PG students, including MBA students; employed professionals seeking to set up their own enterprises; entrepreneurs and start-up founders seeking additional perspectives.

INDUSTRIES APPLICABLE TO : Start-ups may give weightage to this course

COURSE OUTLINE :

This course provides a detailed overview of entrepreneurship as the foundation of business growth and value creation in the national economy. It provides multiple constructs for entrepreneurs to be successful, and pathways for their companies to achieve sustainable growth. Each week/module of the course will cover one specific theme/topic with conceptual perspectives as well as practical examples.

Upon successful completion of the course, the student will gain an expansive and deep appreciation of entrepreneurship, and its pivotal role in the economy. The student or aspiring entrepreneur will be able to approach entrepreneurship with clarity and focus, and an enhanced understanding of the key success factors as well as possible risks and potential mitigation strategies. A practising entrepreneur is likely to be able to navigate the opportunities and challenges of entrepreneurship more effectively with the additional insights available.

ABOUT INSTRUCTOR :

Prof. C. Bhaktavatsala Rao received his Ph.D. Degree in Industrial Management and M.Tech. Degree in Industrial Engineering from the Indian Institute of Technology Madras, Chennai. He received his B.E. Degree in Mechanical Engineering from Sri Venkateswara University, Tirupati. Dr. C. B. Rao has over 46 years of diversified experience in driving business and organizational growth in reputed world-class Indian companies, including subsidiaries of global MNCs. His expertise and experience covers pharmaceutical and automobile industries as well as other industries. He led multiple value-adding growth initiatives in the companies he was associated with, spanning conceptualization, execution, and development of green-field and brown-field projects. Dr. C. B. Rao's recent formal leadership assignment was as Executive Chairman and Managing Director at Pfizer Healthcare India Private Limited (2010-2015). In 2016, Dr. Rao founded LeaderCrest Academy to share his experience and expertise with professional and academic communities. LeaderCrest is currently into high quality academic publishing. Dr. C. B. Rao serves as Ajit Singhvi Chair Professor in Management Studies at the Indian Institute of Technology Madras, Chennai. He also supports select global and Indian corporations as Senior Advisor and Director on the Boards. Dr. C. B. Rao has contributed over 170 papers in reputed management journals and business forums. He has authored and published nine books on strategy and leadership under the LeaderCrest banner over the last five years. Dr. C. B. Rao's teaching and research interests include competitive strategy, strategic management, business leadership and entrepreneurship, among others.

COURSE PLAN :

The course structure and content covers, over a period of 12 weeks, the following 15 modules.

Module 1: Entrepreneurial Journey

Module 2: Entrepreneurial Discovery

Module 3: Ideation and Prototyping

Module 4: Testing, Validation and Commercialisation

Module 5: Disruption as a Success Driver

Module 6: Technological Innovation and Entrepreneurship – 1

Module 7: Technological Innovation and Entrepreneurship – 2

Module 8: Raising Financial Resources

Module 9: Education and Entrepreneurship

Module 10: Beyond Founders and Founder-Families

Module 11: India as a Start-up Nation

Module 12: National Entrepreneurial Culture

Module 13: Entrepreneurial Thermodynamics

Module 14: Entrepreneurship and Employment

Module 15: Start-up Case Studies

Fluid Mechanics - Video course

COURSE OUTLINE

Properties of fluids and fundamental concepts, Fluid statics and its applications, Kinematics of fluids, Conservation equations in fluid flow and its applications, Incompressible viscous flow with applications to pipe flow in practice, Principles of similarity, Flow of ideal fluids, Flow with free surface, Few unsteady flow phenomena in practice, Introduction to laminar boundary layer, Introduction to turbulent flow,

The course coverage is balanced with analytical treatments, physical concepts and practical applications.

COURSE DETAIL

Modules	Lecture Topics
Module: 1	Lecture 1: Introduction and Fundamental Concepts Part-I Lecture 2: Introduction and Fundamental Concepts Part-II Lecture 3: Introduction and Fundamental Concepts Part-III
Module: 2	Lecture 4: Fluid Statics Part-I Lecture 5: Fluid Statics Part-II Lecture 6: Fluid Statics Part-III Lecture 7: Fluid Statics Part-IV Lecture 8: Fluid Statics Part-V Lecture 9: Fluid Statics Part-VI
Module: 3	Lecture 10: Kinematics of Fluid Part-I Lecture 11: Kinematics of Fluid Part-II Lecture 12: Kinematics of Fluid Part-III
Module: 4	Lecture 13: Conservation Equations in Fluid Flow Part-I Lecture 14: Conservation Equations in Fluid Flow Part-II
Module: 5	Lecture 15: Conservation Equations in Fluid Flow Part-III Lecture 16: Conservation Equations in Fluid Flow Part-IV Lecture 17: Conservation Equations in Fluid Flow Part-V Lecture 18: Conservation Equations in Fluid Flow Part-VI Lecture 19: Conservation Equations in Fluid Flow Part-VII Lecture 20: Conservation Equations in Fluid Flow Part-VIII Lecture 21: Conservation Equations in Fluid Flow Part-IX
Module: 6	Lecture 22: Fluid Flow Applications Part-I Lecture 23: Fluid Flow Applications Part-II Lecture 24: Fluid Flow Applications Part-III Lecture 25: Fluid Flow Applications Part-IV Lecture 26: Fluid Flow Applications Part-V



NPTEL

<http://nptel.iitm.ac.in>

Mechanical Engineering

Coordinators:

Prof. S.K. Som

Department of
Mechanical
Engineering IIT Kharagpur

	Lecture 27: Fluid Flow Applications Part-VI Lecture 28: Fluid Flow Applications Part-VII
Module: 7	Lecture 29: Incompressible Viscous Flows Part-I Lecture 30: Incompressible Viscous Flows Part-II Lecture 31: Incompressible Viscous Flows Part-III Lecture 32: Incompressible Viscous Flows Part-IV
Module: 8	Lecture 33: Application of Viscous Flow through Pipes Part-I Lecture 34: Application of Viscous Flow through Pipes Part-II Lecture 35: Application of Viscous Flow through Pipes Part-III
Module: 9	Lecture 36: Principles of Similarity Part-I Lecture 37: Principles of Similarity Part-I Lecture 38: Principles of Similarity Part-I
Module: 10	Lecture 39: Flow of Ideal Fluids Part-I Lecture 40: Flow of Ideal Fluids Part-II
Module: 11	Lecture 41: Flows with a Free Surface Part-I Lecture 42: Flows with a Free Surface Part-II Lecture 43: Flows with a Free Surface Part-III
Module: 12	Lecture 44: A Few unsteady Flow Phenomena Part-I Lecture 45: A Few unsteady Flow Phenomena Part-II
Module: 13	Lecture 46: Introduction to Laminar Boundary Layer Part-I Lecture 47: Introduction to Laminar Boundary Layer Part-II
Module: 14	Lecture 48: Introduction to Turbulent Flow Part-I Lecture 49: Introduction to Turbulent Flow Part-II

References:

1. S K Som, G Biswas, Suman Chakraborty, Introduction to Fluid Mechanics and Fluid machines, Tata McGraw Hill Education.
2. R. W. Fox, P. J. Pritchard, A. T McDonald, Introduction to Fluid Mechanics, John Wiley
3. F. M White, Fluid Mechanics, Tata McGraw Hill Education.



FOUNDATION OF CLOUD IOT EDGE ML

PROF. RAJIV MISRA

Department of Computer Science & Engineering
IIT Patna

PRE-REQUISITES : Basics of Computer Architecture and Organization, Networking

INTENDED AUDIENCE : CSE, ECE, EE

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE :

The disrupted conventional computing models for internet of things(IoT), cloud computing, machine learning and embedded technologies have emerging computing paradigms called as Edge Computing . Computing has taken many shapes from edge to cloud. This course has been designed with an objective to provide a comprehensive understanding of relevant technologies (IoT, ML and Cloud) for various emerging computing paradigms of Edge Computing. Emerging applications of Internet of Things (IoT) such as augmented reality, self-driving cars, and many more are delay sensitive and computation intensive involve computing with large amount of data generated from massively distributed end users require real-time processing. Although the success of cloud computing for supporting high performance computing has been witnessed in recent years, its inefficiency in quality of service (QoS) provisioning for delay sensitive applications as well as high energy consumption has been the bottleneck for the development of delay-sensitive IoT applications. Edge computing has recently emerged as an extension to cloud computing for QoS provisioning for delay-sensitive applications. It supports cloud-like computing in the network edge by deploying computing and network resources along the path between data source and cloud datacenters. This course provides an in-depth understanding of terminologies and the core concepts behind Cloud-IoT-Edge problems, applications, systems and the techniques, that underlie today's cutting-edge technologies. It provides an introduction to some of the start-of-the-art IoT and wireless networks, edge and virtualization technologies, recent trends in computer hardware for artificial intelligence, spatial localization and detection, tensor processing unit for fast and affordable artificial intelligence (AI). And while discussing the concepts and techniques, we will also look at various applications of Cloud-IoT-Edge using Machine Learning, Deep Learning, and many others. The course is suitable for all UG/PG students and practicing engineers/ scientists from the diverse fields and interested in learning about the novel cutting edge techniques and applications of Cloud-IoT-Edge.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is working in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelor's of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile, Adhoc and Sensor Networks, Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 70 papers in high quality journals and conferences, and 2 book chapters. His h-index is 10 with more than 590 citations. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, IEEE Systems Journal, Adhoc Networks, Computer Network, Journal of Parallel and Distributed Computing. He has edited a book titled as "Smart Techniques for a Smarter Planet: Towards Smarter Algorithms" for the "Studies in Fuzziness and Soft Computing" book series, Springer (2018). He has supervised four Phd students and currently four Phd students working under his supervision in the area of big data, cloud computing, distributed computing, and sensor networks. He is a senior member of the IEEE and fellow of IETE. He has completed as the Principal Investigator of R&D Project Sponsored by DeITY entitled as "Vehicular Sensor and Mesh Networks based Future ITS". He has mentored the online courses on Cloud Computing, Advanced Graph Theory and Distributed Systems in the platform of NPTEL.

COURSE PLAN :

Week 1: Introduction to Cloud, Internet of Things (IoT), and Edge Computing Paradigms

Week 2: Integrating Cloud+ IoT + Edge Infrastructures: System Modeling and Research Challenges in Federating Edge Resources

Week 3: Management and Orchestration of Network Slices in 5G, Edge, and Clouds

Week 4: Introduction to Lightweight Container Middleware for Edge Cloud Architectures

Week 5: Data Management and Predictive Analysis to Support Edge Application Deployment

Week 6: Edge Computing Realization for Big Data Analytics

Week 7: Introduction to Machine Learning Services at Public Cloud (AWS Sage Maker)

Week 8: Use Cases for Machine Learning and Deep Learning at the Edge: Smart Surveillance Video Stream Processing, AR/VR, Health Monitoring and Self-driving cars



FUNCTIONAL AND CONCEPTUAL DESIGN

PROF. ASOKAN T

Department of Design Engineering
IIT Madras

INTENDED AUDIENCE : Undergraduate/graduate students interested in new product development

COURSE OUTLINE :

Introduce Engineering Design as a structured process, different from the Conventional Design Engineering. Learn the importance of Systematic Design Process in Product Design Identify various steps involved in the design process. Learn the importance of function and form in the design process Apply the systematic design process for product development.

ABOUT INSTRUCTOR :

Prof. T Asokan is a Professor in the Department of Engineering Design, and currently the Head of the Department, at IIT Madras. He completed his B.Tech. and M.Tech. in mechanical engineering and received his Ph.D in Mechanical Engineering from the Indian Institute of Technology Madras. Prior to joining IIT Madras, he was with the Robotics Research Center, Nanyang Technological University, Singapore working in the area of robotic system development. He was awarded the Stanford-India biodesign fellowship by the Stanford University, USA in 2009 and has completed a post doctoral fellowship in medical device development at the Stanford University. He is currently the national secretary of The Robotics Society. He has more than 25 years of professional experience in research and teaching in the broad areas of Robotics, Product design, and Engineering System design. Prof. Asokan has published more than 100 papers in International Journals and conferences and has filed 18 patents in India, USA, and Singapore. More details can be found at <https://ed.iitm.ac.in/~asokan/>

COURSE PLAN :

Week 1 : Introduction, Birth and Growth of a Product

Week 2 : Types of Design, Stage-Gate and Spiral Design, Stages in New Product Development, Laboratory Exercise - 1

Week 3 : Reverse Engg. and Redesign, Technical Questioning and Mission Statement, Mission Statement-Examples, Laboratory Exercise – 2

Week 4 : Identifying Customer Needs, Customer Need Analysis, Product Specifications, Laboratory Exercise - 3

Week 5 : Need - Metric Matrix, Establishing Target Specifications, HoQ, Laboratory Exercise 4

Week 6 : Functional Decomposition, FAST Method, Laboratory Exercise - 5

Week 7 : Function Structure (Flow Method), Flow Method Examples, Laboratory Exercise - 6

Week 8 : Product and Portfolio Architecture, Portfolio Architecture Selection Laboratory Exercise - 7

Week 9 : Product Architecture, Identification of Modules, Laboratory Exercise - 8

Week 10: Concept Development, Intuitive Methods, Laboratory Exercise - 9

Week 11: Logical Method- TRIZ, Concept Selection, Laboratory Exercise 10

Week 12: Concept Scoring, Laboratory exercise 11



FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES

PROF. SAJJAN KAPIL

Department of Mechanical Engineering
IIT Guwahati

INTENDED AUDIENCE : Bachelor/Master/PhD students having background in Mechanical Engineering/Production Engineering/Manufacturing Technology

COURSE OUTLINE :

The progress of additive manufacturing processes is ever increasing with the development of the digital platform in the manufacturing sector, which is essential for the growth of modern technologies. This course is primarily designed for fundamental understanding of different additive manufacturing technologies for realizing the metallic and non-metallic objects. The syllabus is oriented to cover from basic understanding to practical applications of this technology to develop the products. Therefore, the academic people, as well as the industrial practitioner both, will be benefitted from this course. The special emphasis is given to link computer interface with the digital manufacturing process and their demonstration using commercially available software. The modules cover almost all the direction of additive manufacturing technologies, and it is blended with fundamental development to the recent technologies. The audience will be able to develop a fundamental understanding of different perspectives and recent development in this field through the lectures, skill development through demonstration, and reinforce their knowledge by solving assignments. This course is presented in a lucid and simplified way to make it enjoyable to the beginners.

ABOUT INSTRUCTOR :

Prof. Sajjan Kapil completed his Bachelor's degree in Mechanical Engineering from G. B. Pant Engineering College Pauri, Master's degree in Computer Assisted Manufacturing from IIT Guwahati & University of Stuttgart and Ph.D. from IIT Bombay. After that, he joined the Department of Mechanical Engineering IIT Guwahati as an Assistant Professor. His areas of research include 3D printing, Manufacturing Automation, and CAD/CAM. At IIT Bombay, he had developed an Additive Manufacturing process called "Hybrid Layered Manufacturing". He had simplified the manufacturing process of complex geometries by generating both 3 and 5-axis metal deposition toolpaths. He has published his research work in 13 international journals, 7 Indian patents, and more than 20 conferences. He has developed a new elective course entitled as 'Additive Manufacturing Technologies' at IIT Guwahati. He is involved in teaching the subjects like 'Additive Manufacturing Technologies', 'Kinematics of Machinery', 'Engineering Drawing', and 'Manufacturing Laboratory', at IIT Guwahati.

COURSE PLAN :

- Week 1 :** Introduction to Additive Manufacturing
- Week 2 :** Computer Aided Process Planning for Additive Manufacturing
- Week 3 :** Computer Aided Process Planning for Additive Manufacturing
- Week 4 :** Liquid Additive Manufacturing
- Week 5 :** Liquid Additive Manufacturing
- Week 6 :** Sheet Additive Manufacturing
- Week 7 :** Wire Additive Manufacturing
- Week 8 :** Wire Additive Manufacturing
- Week 9 :** Wire Additive Manufacturing
- Week 10 :** Powder Additive Manufacturing
- Week 11 :** Powder Additive Manufacturing
- Week 12 :** Powder Additive Manufacturing



FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

PROF. SHYAMANTA M. HAZARIKA

Department of Mechanical Engineering
IIT Guwahati

PRE-REQUISITES : Basic Course in Probability and Linear Algebra

INTENDED AUDIENCE : Final Year B.Tech/M.Tech and PhD students

COURSE OUTLINE :

What does automatic scheduling or autonomous driving have in common with web search, speech recognition, and machine translation? These are complex real-world problems that span across various practices of engineering! Aim of artificial intelligence (AI) is to tackle these problems with rigorous mathematical tools. The objective of this course is to present an overview of the principles and practices of AI to address such complex real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

ABOUT INSTRUCTOR :

Prof. Shyamanta M Hazarika is a Professor of Mechanical Engineering at IIT Guwahati and leads the Biomimetic Robotics and Artificial Intelligence Lab. His research interest is in Rehabilitation Robotics. This translates into interest in Artificial Intelligence, Biomimetic Robotics and Robotic Neurorehabilitation. Prior to joining IIT Guwahati, he was with the Department of Computer Science and Engineering, Tezpur University. He has been a Vertretungsprofessur of Cognitive Systems and Neuroinformatics, University of Bremen, Germany. Prof. Hazarika holds a B.E. in Mechanical Engineering from Assam Engineering College, Guwahati, India; M.Tech. in Robotics from Center for Robotics, IIT Kanpur, India. He completed his PhD in Artificial Intelligence (Knowledge Representation and Reasoning) from School of Computing, University of Leeds, England.

COURSE PLAN :

Week 1: AI and Problem Solving by Search

Week 2: Problem Solving by search

Week 3: Problem Solving by search (contd)

Week 4: Knowledge Representation and Reasoning

Week 5: Knowledge Representation and Reasoning (Contd)

Week 6: Knowledge Representation and Reasoning (contd)

Week 7: Reasoning under uncertainty

Week 8: Planning

Week 9: Planning and Decision Making

Week 10: Machine Learning

Week 11: Machine Learning (contd)

Week 12: Machine Learning (contd)



FUNDAMENTALS OF AUTOMOTIVE SYSTEMS

PROF. C. S. SHANKAR RAM

Department of Design Engineering

IIT Madras

PRE REQUISITES: Rigid Body Dynamics (done in 1st year BE), Thermodynamics, Fluid Mechanics

INTENDED AUDIENCE: 3rd/4th year undergraduate and 1st year M.Tech./M.S./Ph.D. students

COURSE OUTLINE :

The objective of this course is to provide a fundamental understanding of the various systems of a typical automobile.

Course Outcomes: At the end of this course, the participant should be able to:

1. acquire fundamental knowledge of the various systems of an automobile,
2. associate the functions of each system with its design and layout, depict the various systems using simple schematics, and apply concepts learnt in core undergraduate courses to synthesize mathematical models of the various systems.

ABOUT INSTRUCTOR :

Prof. C. S. Shankar Ram is currently a professor in the Department of Engineering Design, Indian Institute of Technology Madras, Chennai, India. He received his Bachelor of Engineering (B. E.) in Mechanical Engineering from Motilal Nehru Regional Engineering College, Allahabad, India, and his M. S. and Ph. D. from Texas A&M University, USA. His research interests are in the areas of dynamics and control with applications to automotive and transportation systems. He teaches courses on Control Systems, Fundamentals of Automotive Systems and Control of Automotive Systems at IIT Madras

COURSE PLAN :

Week 1 : Course Overview, Classification of Internal Combustion Engines, Engine Components, Operation of Four Stroke Engines

Week 2 : Two Stroke Engines, Engine Cycles

Week 3 : Engine Performance, Supercharging, Combustion in Spark Ignition Engines

Week 4 : Combustion in Compression Ignition Engines, Carburetion, Fuel Introduction Systems

Week 5 : Engine Emissions, Emission Control Systems, Automotive Powertrain

Week 6 : Automotive Clutch, Transmission, Powertrain Analysis

Week 7 : Transmission Matching and Introduction to Brake System

Week 8 : Components of Brake System, Hydraulic Brake

Week 9 : Air Brake, Antilock Brake System

Week 10 : Braking Analysis, Introduction to Steering System, Manual Steering System

Week 11 : Power Steering System, Wheel Alignment, Introduction to Suspension System

Week 12 : Components of Suspension System, Dependent and Independent Suspension, Introduction to Electric and Hybrid Powertrain, Tyres.



FUNDAMENTALS OF MIMO WIRELESS COMMUNICATION

PROF. SUVRA SEKHAR DAS

Department of Electronics and Communications Engineering
IIT Kharagpur

PRE-REQUISITES : Course on "Power System Engineering", which is generally offered in 2nd year/third year of B.Tech program

INTENDED AUDIENCE : B.Tech fourth year/M.Tech

INDUSTRIES APPLICABLE TO : PGCIL, NHPC, all state power transmission companies

COURSE OUTLINE :

This course introduces the computational aspects of the power system analysis. The thrust of this course is description of the computer algorithms for analysis of any general power transmission system. Starting with load flow analysis, which is essentially the backbone of any power system analysis tool, this course further deals with computer algorithms for contingency analysis, state estimation and phase domain fault analysis method of any general power transmission system.

ABOUT INSTRUCTOR :

Prof. Suvra Sekhar Das is currently serving as associate professor at the G. S. Sanyal School of Telecommunications in Indian Institute of Technology Kharagpur. He has completed Ph.D. from Aalborg University, Aalborg, Denmark. He has worked as Senior Scientist with the Innovation Laboratory of Tata Consultancy Services. His research interests include cross-layer optimization of mobile broadband cellular networks, 5G, Broadband Mobile Communications, 5G Waveform design GFDM FBMC UPMC, heterogeneous networks Femto Cells Device to Device communication, Multi objective optimization for radio access networks, Green radio network design Packet Scheduling and radio resource allocation with link adaptation, MIMO communications, base-band transceiver design for broadband wireless communication systems. He has delivered several tutorials and seminars on next generation wireless communications. He has guided several PhD students, published several research papers in international journals and conferences. He has co-authored two books titled "Adaptive PHY-MAC Design for Broadband Wireless Systems" and "Single- and Multi-Carrier MIMO Transmission for Broadband Wireless Systems". He has developed teaching resource "fading channel and mobile communications" freely available as interactive web material for learners of mobile communications (<http://fcmcvlab.iitkgp.ac.in/> with nearly 2 lacs hits). He has taught several subjects such as Modern digital communication techniques, Broadband access systems, mobile communications and fading, teletraffic engineering, introduction to wireless communication and MIMO communications.

COURSE PLAN :

Week 1: Introduction to wireless communication systems and wireless channels

Week 2: Wireless channel models

Week 3: MIMO channel model

Week 4: Information Theory basics for MIMO communication

Week 5: Capacity of MIMO Communication systems

Week 6: Diversity performance of MIMO channels

Week 7: Space Time Coding schemes

Week 8: Multi-user MIMO communications



FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS

PROF. NISHCHAL KUMAR VERMA

Department of Electrical Engineering
IIT Kanpur

INTENDED AUDIENCE : UG, PG Students, industry professionals, researchers etc.

COURSE OUTLINE :

The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

ABOUT INSTRUCTOR :

Prof. Nishchal K Verma (SM'13) is Professor, Department of Electrical Engineering and Inter-disciplinary Program in Cognitive Science, Indian Institute of Technology Kanpur, India. He obtained his PhD in Electrical Engineering from Indian Institute of Technology Delhi, India. He is an awardee of Devendra Shukla Young Faculty Research Fellowship by Indian Institute of Technology Kanpur, India for year 2013-16. His research interests include big data analysis, deep learning of neural and fuzzy networks, machine learning algorithms, computational intelligence, computer vision, brain computer/machine interface, intelligent informatics, soft-computing in modelling and control, internet of things/ cyber physical systems, cognitive science and intelligent fault diagnosis systems, prognosis and health management. He has authored more than 200 research papers. Dr. Verma is an IETE Fellow. He is currently serving as Guest Editor of the IEEE Access special section "Advance in Prognostics and System Health Management", an Editor of the IETE Technical Review Journal, an Associate Editor of the IEEE Transactions on Neural Networks and Learning Systems, an Associate Editor of the IEEE Computational Intelligence Magazine, an Associate Editor of the Transactions of the Institute of Measurement and Control, U.K. and Editorial Board Member for several journals and conferences.

COURSE PLAN :

Week 1: Introduction and Fuzzy Sets Theory

Week 2: Membership Functions

Week 3: Set Theoretic Operations

Week 4: Fuzzy Arithmetic

Week 5: Fuzzy Relations

Week 6: Fuzzy Inference Systems I

Week 7: Fuzzy Inference Systems II

Week 8: Wang and Mendel Model

Week 9: TSK Model

Week 10: Fuzzifiers and Defuzzifiers

Week 11: ANFIS Architecture

Week 12: Fuzzy Systems and Machine Learning



GERMAN - I

PROF. MILIND BRAHME

Department of Humanities and Social Sciences
IIT Madras

INTENDED AUDIENCE : Anyone interested in learning elementary German

INDUSTRIES APPLICABLE TO : Companies / Organisations / Individuals having business / work with Germany, Austria and/or Switzerland

COURSE OUTLINE :

German I is meant to be an introduction to the German language and a basic orientation towards Germany (and to some extent Austria and Switzerland). Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of Germany as a cultural space are the overall objectives of the course. Serious learners should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

ABOUT INSTRUCTOR :

Prof. Milind Brahme has an MA, M Phil and a PhD in German language and literature from the Centre of German Studies, JNU. He has been on the faculty of IIT Madras since 2003, and has more than 25 years of experience of teaching German language and literature in diverse situations and contexts.

COURSE PLAN :

Week 1: Themes: Introducing oneself and others; Grammar: W questions, personal pronouns, simple sentence, verb conjugation

Week 2: Themes: hobbies, the week, numbers, the alphabet, months, seasons / Grammar : articles , plural, the verbs to have and to be

Week 3: Theme: In the city / naming places and buildings, means of transport, basic directions / Grammar : definite and indefinite articles; negation - kein and nicht; imperative

Week 4: Themes: food, drink, family / groceries and meals / Grammar : the accusative

Week 5: Theme: Everyday life, telling time, making appointments / Grammar : prepositions am, um, von...bis; modal verbs, possessive articles

Week 6: Leisure activity, celebrations / Grammar: separable verbs, the accusative, past tense of to have and to be

Week 7: Contacts, writing letters / Grammar: dative

Week 8: My apartment, rooms, furniture, colours / Grammar: changing prepositions

Week 9: Professions / Grammar : perfect tense

Week 10: Clothes / Grammar: perfect tense and dative

Week 11: Health and the body / Grammar: the imperative and modal verbs

Week 12: Holiday and weather



GETTING STARTED WITH COMPETITIVE PROGRAMMING

PROF. NEELDHARA MISRA

Department of Computer Science

IIT Gandhinagar

PREREQUISITES : Data Structures and Algorithms, Familiarity with a programming language (ideally C++ or Python)

INTENDED AUDIENCE : Undergraduate students who have already done a basic data structures/algorithms course.

INDUSTRIES APPLICABLE TO : Most technology-based companies typically hire based on a test of coding competence and this course will prepare students for this. Notable examples include: Facebook, Google, Amazon, Apple, Microsoft, etc.

COURSE OUTLINE :

This is a course on algorithm design with a focus on issues of modeling and implementation. Each lecture will be focused entirely on one or two problems that reveal the use of a specific algorithmic technique. The techniques themselves are chosen to be in line with those covered in existing NPTEL courses on data structures and algorithms, so that students who complete those courses can find in this course a natural follow up. This course is intended for anyone who wants to deepen their appreciation for algorithmic techniques that they have learned in a foundational course and/or would like to take a first step towards preparing for coding competitions such as the ICPC.

ABOUT INSTRUCTOR :

Prof. Neeldhara Misra is an Assistant Professor of Computer Science and Engineering at the Indian Institute of Technology, Gandhinagar. Her primary research interest involves the design and analysis of efficient algorithms for “hard” problems in general, and parameterized algorithms in particular. The problems considered are typically concerned with combinatorial optimization, frequently in the context of graph theory, social choice, games, geometry, and constraint satisfaction.

COURSE PLAN :

Week 1: Sorting and Searching Algorithms

Week 2: Greedy Algorithms - I

Week 3: Greedy Algorithms - II

Week 4: Disjoint Set Union with Path Compression

Week 5: Minimum Spanning Tree

Week 6: Shortest Paths: Dijkstra and Beyond

Week 7: Network Flows - I

Week 8: Network Flows - II, Divide and Conquer

Week 9: Dynamic programming - I

Week 10: Dynamic programming - II

Week 11: Dynamic programming - III

Week 12: Dynamic programming - IV



GOOGLE CLOUD COMPUTING FOUNDATIONS

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Guwahati

COURSE OUTLINE :

The Google Cloud Computing Foundations course aims to provide a detailed overview of concepts covering cloud basics, big data, and machine learning and where and how the Google Cloud Platform fits in. The course involves understanding concepts and perform hands-on training (via Qwiklabs platform) to practice the learning. There are 26 labs on Qwiklabs that are part of the course.

Those enrolling for the course should ideally:

- Have basic IT knowledge and be interested in learning more about Cloud and ML.
- Have competency in at least one language (such as Python, Java).
- Be familiar with the basics of shell scripting, SQL.

Disclaimer:

Google may contact you by email to provision benefits and send surveys and other communication related to the Google Cloud Computing Foundations Course.

By joining, you agree to Google Cloud Training tracking your grades and other activity in it's learning program.

ABOUT INSTRUCTOR :

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN :

Week 0: Introduction to the course

Week 1: So, What's the Cloud anyway? Start with a Solid Platform

Week 2: Use GCP to build your Apps

Week 3: Where do I store this stuff?

Week 4: There's an API for that! You can't secure the Cloud right?

Week 5: It helps to network!

Week 6: It helps to network (continued)

Week 7: Let Google keep an eye on things. You have the data, but what are you doing with it?

Week 8: Let machines do the work



HARDWARE MODELING USING VERILOG

PROF. INDRANIL SENGUPTA

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE: Computer Science and Engineering ; Electronics and Communication Engineering ; Electrical Engineering

PRE-REQUISITES : Basic concepts in digital circuit design ; Familiarity with a programming language like C or C++

INDUSTRY SUPPORT : Intel, Cadence, Mentor Graphics, Synopsys, Xilinx.

COURSE OUTLINE:

The course will introduce the participants to the Verilog hardware description language. It will help them to learn various digital circuit modeling issues using Verilog, writing test benches, and some case studies.

ABOUT INSTRUCTOR:

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

COURSE PLAN:

Week 1: Introduction to digital circuit design flow (3 hours)

Week 2: Verilog variables, operators and language constructs (2 hours)

Week 3: Modeling combinational circuits using Verilog (2 hours)

Week 4: Modeling sequential circuits using Verilog (3 hours)

Week 5: Verilog test benches and design simulation (2 hours)

Week 6: Behavioral versus structural design modeling (2 hours)

Week 7: Miscellaneous modeling issues: pipelining, memory, etc. (2 hours)

Week 8: Processor design using Verilog (4 hours)



HYDROGEN ENERGY: PRODUCTION, STORAGE, TRANSPORTATION AND SAFETY

PROF. PRATIBHA SHARMA

Department of Energy Science and Engineering
IIT Bombay

INTENDED AUDIENCE : UG, PG and PhD students from Chemical Engineering, Mechanical Engineering, Energy Science, Energy Engineering, Energy Systems Engineering disciplines, however it is open to all those interested; faculty and industry personnel interested in hydrogen energy

INDUSTRY SUPPORT : Oil and Gas PSUs, Renewables based industries, Energy systems related industries

COURSE OUTLINE :

The course will comprehensively cover all the aspects of the hydrogen energy value chain including production methods from hydrocarbons & renewables, separation & purification, storage, transportation & distribution, refueling, utilization in various sectors, associated energy conversion devices, sensing and safety. Technical comparisons of various processes and technologies, economic aspects & cost analysis, regulations, codes and standards, global status and future directions will be discussed. The course will provide a broad knowledge of hydrogen as an energy carrier, the way it will play an important role in various sectors towards decarbonization, current limitations and future scenarios.

ABOUT INSTRUCTOR :

Prof. Pratibha Sharma is a Professor in the department of Energy Science and Engineering (DESE) at IIT Bombay. Her research interest lies in the field of hydrogen energy specifically solid state hydrogen storage materials, storage systems design and development for various applications. She is leading several multi-institutional projects on hydrogen where several other IITs, industries and research organisation are collaborating. She has several international collaborations and also established a multi-institutional R & D centre on Hydrogen at IIT Bombay. At IIT Bombay she has established four different research laboratories: (i) Hydrogen Storage Lab, (ii) DST- IIT Bombay Energy Storage Platform on Hydrogen (ESPHy), (iii) Energy Materials Synthesis Lab and (iv) Hydrogen Systems and Application Lab (HySAL). She has been teaching the course on Hydrogen Energy (EN 610) since 2010.

COURSE PLAN :

Week 1 : Properties of hydrogen, global status of supply and demand, methods of hydrogen production, steam reforming, tutorial

Week 2 : Advanced methods of steam reforming, partial oxidation, autothermal reforming, combined reforming, reforming using alternate energy sources, tutorial

Week 3 : Hydrogen production from methane decomposition, from coal and biomass, tutorial

Week 4 : Hydrogen separation and purification, thermochemical cycles for hydrogen production, fundamentals for electrolysis of water

Week 5 : Components of electrolytic cell, configuration of electrolyzer stack, different electrolyzer technologies, photoelectrochemical hydrogen production, technical and economic comparison of different production methods and global status, cost analysis, tutorial

Week 6 : Introduction to hydrogen storage, underground hydrogen storage, fundamentals of hydrogen compression and expansion

Week 7 : Mechanical and non-mechanical hydrogen compressors; compressed hydrogen tank types and design considerations, tutorial

Week 8 : Hydrogen liquefaction, liquid state hydrogen storage tanks, fundamentals of hydrogen storage in adsorption based materials

Week 9 : Fundamentals and thermodynamics of absorption based hydrogen storage, metal hydrides, types of metal hydrides, metal hydride based systems design, tutorial

Week 10 : Novel materials for solid state hydrogen storage; economics of storage; Long distance hydrogen transport via pipelines, ships and in form of LOHC; hydrogen transport via road; hydrogen refueling stations

Week 11: Use of hydrogen in internal combustion engines, fuel cells, hydrogen sensing

Week 12 : Properties of hydrogen associated with hazards, classification of hydrogen hazards, compressed and liquid hydrogen related hazards, regulation, codes and standards, utilization of hydrogen in various sectors, global status and future directions

Industrial Automation and Control - Video course

1. Lecture 1: Introduction to Industrial Automation and Control
2. Lecture 2: Architecture of Industrial Automation Systems.
3. Lecture 3: Introduction to sensors and measurement systems
4. Lecture 4: Temperature measurement
5. Lecture 5: Pressure and Force measurements
6. Lecture 6: Displacement and speed measurement
7. Lecture 7: Flow measurement techniques
8. Lecture 7: Measurement of level, humidity, pH etc
9. Lecture 8: Signal Conditioning and Processing
10. Lecture 10: Estimation of errors and Calibration
11. Lecture 3: Introduction to Process Control.
12. Lecture 4: P-- I -- D Control
13. Lecture 5: Controller Tuning.
14. Lecture 6: Implementation of PID Controllers
15. Lecture 7: Special Control Structures : Feedforward and Ratio Control.
16. Lecture 8: Special Control Structures : Predictive Control, Control of Systems with Inverse Response
17. Lecture 9: Special Control Structures : Cascade Control, Overriding Control, Selective Control, Split Range Control
18. Lecture 10: Introduction to Sequence Control, PLCs and Relay Ladder Logic
19. Lecture 11: Sequence Control : Scan Cycle, RLL Syntax
20. Lecture 12: Sequence Control : Structured Design Approach
21. Lecture 13: Sequence Control : Advanced RLL Programming
22. Lecture 14: Sequence Control : The Hardware environment
23. Lecture 15: Control of Machine tools : Introduction to CNC Machines
24. Lecture 16: Control of Machine tools : Analysis of a control loop
25. Lecture 17: Introduction to Actuators : Flow Control Valves
26. Lecture 18: Hydraulic Actuator Systems : Principles, Components and Symbols
27. Lecture 19: Hydraulic Actuator Systems : Pumps and Motors,
28. Lecture 20: Proportional and Servo Valves
29. Lecture 20: Pneumatic Control Systems : System Components
30. Lecture 21: Pneumatic Control Systems : Controllers and Integrated Control Systems



NPTEL

<http://nptel.ac.in>

**Electrical
Engineering**

Coordinators:

Prof. S. Mukhopadhyay
Department of Electrical
Engineering IIT Kharagpur

Prof. S. Sen
Department of Electrical
Engineering IIT Kharagpur

31.Lecture 22: Electric Drives : Introduction, Energy Saving with Adjustable Speed Drives

32.Lecture 23: Step motors : Principles, Construction and Drives

33.Lecture 24: DC Motor Drives : Introduction, DC--DC Converters, Adjustable Speed Drives

34.Lecture 25: Induction Motor Drives: Introduction, Characteristics, Adjustable Speed Drives

35. Lecture 26 : Synchronous Motor Drives : Motor Principles, Adjustable Speed and Servo Drives

36. Lecture 27 : Networking of Sensors, Actuators and Controllers : The Fieldbus

37. Lecture 28 : The Fieldbus Communication Protocol

38. Lecture 29 : Introduction to Production Control Systems

39. Lecture 30 : Concluding Lecture



INTRODUCTION TO ATMOSPHERIC AND SPACE SCIENCES

PROF. MV SUNIL KRISHNA

Department of Physics

IIT Roorkee

PRE-REQUISITES : BSc level Physics / B.Tech (I) level Physics course

INTENDED AUDIENCE : M.Sc (Physics), MSc (Chemistry), MSc (Mathematics), M.Tech (Atmospheric Science), B.Tech (Civil), B.Tech (Mechanical), B.Tech (Chemical), Pre-PhD

INDUSTRIES APPLICABLE TO : ISRO, CSIR, DRDO

COURSE OUTLINE :

This course introduces the basics of Earth's atmosphere to graduate and post-graduate students. It starts from the evolution of atmosphere and gives understanding of various physical and chemical processes responsible for the observed changes we see in weather and climate. It gives a comprehensive understanding of neutral atmosphere, ionosphere and various plasma processes. This course will introduce the fundamentals of the various interrelations in atmospheric and space physics, the basic scientific methods and techniques.

ABOUT INSTRUCTOR :

1. M.Sc. (Physics) from Sri Venkateswara University, Tirupati
2. M.Phil (Theoretical High Energy Physics) from University of Hyderabad
3. Ph.D (Atmospheric and Space Physics), IIT Roorkee Assistant Professor in Physics at IIT Roorkee since 2011.

I carry research in the area of atmospheric and space physics. With specific interest in understanding the space weather effects on the neutral atmosphere and ionosphere by combining satellite, ground based measurements and modeling techniques. Our research group at IIT Roorkee tries to understand how intense solar prominences such as solar flares and coronal mass ejections effect the geospace in general and the mesosphere-thermosphere and ionosphere in particular.

COURSE PLAN :

Week 1 : Atmospheric evolution, solar radiation, present day atmospheric constituents, various stages in the evolution of earth's atmosphere, formation of ozone, carbon budget, oxygen chemistry and life on earth.

Week 2 : Variation of temperature with height, density and ionization with altitude, classification of atmosphere based on temperature and pressure, hydrostatic equation, hypsometric equation

Week 3 : Fundamental forces, non-inertial forces, momentum equations governing the motions in atmosphere, curvature effect, various scales of atmospheric motions.

Week 4 : Hydrostatic equilibrium, hypsometric equation, geopotential height, thermodynamic system, equilibrium state, stability, gas laws, Avogadro hypothesis, gas constant, dry air, mixture of gases, mean molecular mass, humidity variables, moist air, virtual temperature

Week 5 : Enthalpy, adiabatic processes, air parcel, mixing ratio and specific humidity, saturation vapor pressure, relative humidity, dew point, frost point, lifting condensation level, wet-bulb temperature, latent heats

Week 6 : Pseudo-adiabatic processes, equivalent potential temperature, parcel lapse rates, convection of air, collision and coalescence processes, cloud formation, ascent of clouds and types, cloud morphology, cloud classification

Week 7 : Atmospheric stability conditions, Brunt-vaisala frequency, stable, unstable and neutral atmosphere

Week 8 : Cloud seeding and precipitation, Droplet growth, curvature effect and solute effect, radial growth of droplets by diffusion

Week 9 : Earth's upper atmosphere, Ionosphere, various layers and chemistry of ionosphere, types of reactions, Chapman's theory of layer production

Week 10 : Hydrogen in ionosphere, Debye's shielding and Debye's potential

Week 11 : Particle motion in uniform electric field, particle motion in uniform magnetic field and guiding center, particle motion in gradient magnetic fields

Week 12 : Gradient drift and curvature drift, vacuum drift and planetary ring current, magnetic mirroring and loss cone, airglow and aurora.



INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic knowledge of computer and internet

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engg, Industrial Engineering, Industry Professionals

INDUSTRIES APPLICABLE TO : All Industrial Sectors

COURSE OUTLINE :

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle. This course has been organized into the following modules:.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN:

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab



INTRODUCTION TO INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic programming knowledge

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engineering, Industrial Engineering

COURSE OUTLINE :

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN :

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud Computing(contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring



INTRODUCTION TO MACHINE LEARNING - IITKGP

PROF. SUDESHNA SARKAR

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : Elective course for UG, PG, BE, ME, MS, M.Sc, PhD

PRE-REQUISITES : Basic programming skills (in Python), algorithm design, basics of probability & statistics

INDUSTRIES APPLICABLE TO : Data science companies and many other industries value machine learning skills.

COURSE OUTLINE :

This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. We will cover the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbour, an introduction to Bayesian learning and the naïve Bayes algorithm, support vector machines and kernels and neural networks with an introduction to Deep Learning. We will also cover the basic clustering algorithms. Feature reduction methods will also be discussed. We will introduce the basics of computational learning theory. In the course we will discuss various issues related to the application of machine learning algorithms. We will discuss hypothesis space, overfitting, bias and variance, tradeoffs between representational power and learnability, evaluation strategies and cross-validation. The course will be accompanied by hands-on problem solving with programming in Python and some tutorial sessions.

ABOUT INSTRUCTOR :

Prof. Sudeshna Sarkar is a Professor and currently the Head of the Department of Computer Science and Engineering at IIT Kharagpur. She completed her B.Tech. in 1989 from IIT Kharagpur, MS from University of California, Berkeley, and PhD from IIT Kharagpur in 1995. She served briefly as faculty at IIT Guwahati and at IIT Kanpur before joining IIT Kharagpur in 1998. Her research interests are in Machine Learning, Natural Language Processing, Data and Text Mining.

COURSE PLAN :

Week 01 : Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

Week 02 : Linear regression, Decision trees, overfitting.

Week 03 : Instance based learning, Feature reduction, Collaborative filtering based recommendation.

Week 04 : Probability and Bayes learning

Week 05 : Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Week 06 : Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

Week 07 : Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

Week 08 : Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.



INTRODUCTION TO MACHINE LEARNING (TAMIL)

PROF. ARUN RAJKUMAR

Department of Computer Science
IIT Madras

INTENDED AUDIENCE: Native Tamil speaking audience (Teachers/ Undergraduate Students)

PREREQUISITES: A basic course in linear algebra/probability/programming/algorithms would be a big plus. These are not strong pre-requisites.

INDUSTRY SUPPORT: All Data centric companies including those that have core business in search/e-commerce/social-media

COURSE OUTLINE:

A short course introducing the main ideas and algorithms of Machine Learning. The goal of the course is to cover the topics at a high level so that it would act as a first course for a full fledged Machine Learning course. The course will be delivered in spoken Tamil while the technical terms discussed/exams/assignments will be in English.

ABOUT INSTRUCTOR:

Prof.Arun Rajkumar is currently an assistant professor in the department of CSE at IIT Madras. His PhD thesis was in the area of Machine Learning and his broad research interests are in the areas of Machine Learning, sequential decision making.

COURSE PLAN:

Week 1: Basics of Linear Algebra, Probability, Optimization

Week 2: Introduction to Supervised Learning - Regression; Topics - Linear Regression; Ridge Regression; LASSO

Week 3: Supervised Learning - Classification; Topics: K-NN, Decision Tree.

Week 4: Supervised Learning - Classification; Topics: Naive Bayes.

Week 5: Supervised Learning - Logistic Regression ,Perceptron.

Week 6: Supervised Learning - Support Vector Machines

Week 7: Supervised Learning - Ensemble Methods

Week 8: Unsupervised Learning - K-means Clustering, PCA



INTRODUCTION TO PROGRAMMING IN C

PROF. SATYADEV NANDAKUMAR

Dept. of Computer Science and Engineering
IIT Kanpur

INTENDED AUDIENCE : Any interested learners.

PRE-REQUISITES : No prior programming required; mathematical maturity of a second level UG student in science or engineering.

COURSE OUTLINE :

This is a course in programming in C. No prior programming experience is assumed; however, mathematical maturity at the level of a second year science or engineering undergraduate is assumed. We emphasize solving problems using the language, and introduce standard programming techniques like alternation, iteration and recursion. We will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams.

ABOUT INSTRUCTOR :

Prof. Satyadev Nandakumar is an Assistant Professor from the Department of Computer Science and Engineering IIT Kanpur who specialises in Computable Analysis, Algorithmic Information Theory, Symbolic Dynamics. His research interests includes Theoretical Computer Science, Algorithmic Information Theory, Computable Analysis.

COURSE PLAN :

Week 01 : Introduction. Straight-Line Code. Variables, Operators, Expressions and Conditionals.

Week 02 : Loops.

Week 03 : Functions.

Week 04 : One-Dimensional Arrays and Pointers.

Week 05 : Recursion.

Week 06 : Multi-dimensional Arrays, Linked Lists.

Week 07 : Operating on Files.

Week 08 : Organizing C projects, working with multiple source directories, makefiles.



LEADERSHIP AND TEAM EFFECTIVENESS

PROF. SANTOSH RANGNEKAR

Department of Management
IIT Roorkee

INTENDED AUDIENCE: B.Tech/ MBA/ Industry/ Faculty/Ph D

INDUSTRIES APPLICABLE TO : It's part of Human Behavior so applicable to all Industries

COURSE OUTLINE :

Course Objectives:

To provide a framework for the students to understand the importance of Leadership and team effectiveness in organizations.

To develop an understanding of the interpersonal processes and group dynamics.

To provide a theoretical understanding of leadership practices in organizations.

To provide an understanding of factors influencing teamwork and team leadership.

To evaluate the role of leadership in the development of an institution.

Course Learning Outcomes

By the end of the course the student should be able to:

Explain how global leadership skills contribute to leadership effectiveness.

Understand the leader's role in team-based organizations.

Explain the potential contribution of outdoor training to the development of team leadership.

Explain the basics of leadership during a crisis.

Explain how evidenced based leadership can contribute to contingency and situational leadership.

ABOUT INSTRUCTOR:

Prof. Santhosh Rangnekar's areas of teaching, training, research & publications:

Teaching: Managerial Practices, Organizational Behavior, Human Resource management

Training: Conducted more than 100 Training Programs worth more than 2 cr, UJVNL, Uttarakhand, 50 Lacs Orientation program, BHEL

Research: Ph. D., 19 Ph D awarded, 10 Pursuing.

Publications: 131 [Journals: 68 Conferences: 49 Books: 02 Magazine: 01 Publications in Text Books: 03 Edited Books: 02 Book review: 06]

COURSE PLAN

Week 1: Introduction to Leadership & Team Management; Leadership Myths; Interactional Framework for analyzing leadership; Leadership Development: The First 90 Days as a Leader; Leader Development- The Action-Observation-Reflection Model

Week 2: LMX Theory and Normative Decision Model; Situational Leadership Model; Contingency Model and Path Goal Theory; Emotional Approach Charismatic and Transformational Leadership; Leadership for Tomorrow

Week 3: Leadership Attributes; Personality Traits and Leadership; Personality Types and Leadership; Intelligence and Leadership; Emotional Intelligence and Leadership

Week 4: Power and Leadership; The art of influence in leadership; Leadership and "Doing the Right Things; Character-Based Approach to Leadership; Role of Ethics and Values in Organisational Leadership

Week 5: Leadership Behaviour; Leadership Pipeline; Assessing Leadership Behaviors: Multi-rater Feedback Instruments; The Dark Side of; Leadership- Destructive Leadership; Managerial Incompetence and Derailment Conflict Management

Week 6: Negotiation and Leadership; Leadership under a crisis situation; The Situation and the Environment; Culture and Leadership; Global Leadership

Week 7: Motivation and Leadership; Introduction to Groups and Teams; Characteristics of Leader, Follower and Situation; Group Dynamics; Team Formation

Week 8: Delegation and Empowerment; Leading teams: Enhancing teamwork within a group; The leader's role in team-based organizations; Leader actions that foster Teamwork Effectiveness; Offsite training and team development

Week 9: Understanding Team processes and Team Coaching; Team decision making and conflict management; Virtual teams; Managing Multicultural teams; Building great teams

Week 10: Experiential Learning; Action Learning; Development Planning: GAP Analysis; Coaching and Mentoring; Women in Leadership Roles

Week 11: Building Effective Relationship with subordinates and peers; Fostering Followers satisfaction; The Art of Communication; Setting Goals and Providing Constructive Feedback; Enhancing Creativity problem solving skills

Week 12: Building High-Performance Teams: The Rocket Model; Building Credibility and Trust; Skills for Developing Others; Team Building at the Top; Community Leadership at the Top; Community Leadership.



MACHINE LEARNING FOR SOIL AND CROP MANAGEMENT

PROF. SOMSUBHRA CHAKRABORTY

Department of Agricultural and Food Engineering.
IIT Kharagpur

INTENDED AUDIENCE : Students of Agricultural Engineering, Agriculture, and Environmental Science

INDUSTRIES APPLICABLE TO :

1. Soil and crop testing services
2. Soil remote sensing solution services
3. AI-based agricultural startups

COURSE OUTLINE :

It is essential to upgrade traditional farming practices and prepare for a technological revolution to develop ECO-friendly systems for enhancing crop productivity. This course aims to cover the various applications of machine learning and deep learning methods for better soil and crop management. This course is specifically designed for those undergraduate students who wish to understand and apply their knowledge of machine learning, deep learning, digital soil mapping, image processing, and portable sensors for developing an integrated and advanced soil and crop management system.

ABOUT INSTRUCTOR :

Prof. Somsubhra Chakraborty is currently serving as an Assistant Professor (Soil Science) at the Agricultural and Food Engineering Department, Indian Institute of Technology Kharagpur. He was awarded various prestigious fellowships including the Australia Awards Fellowship from the Australian Department of Foreign Affairs and Trade. He did his undergraduate and M.Sc degrees from BCKV and PAU in India, respectively, and PhD degree in Agronomy (Soil Science emphasis) from Louisiana State University, USA. He started his career as a post-doctoral researcher at West Virginia University, USA. He joined IITKgp as faculty in 2016. His research interest is the use of proximal and non-invasive sensors with machine learning for soil management. He has around 80 international journal publications. He is currently serving as the member of the editorial board of Geoderma, the global journal of soil science.

COURSE PLAN :

Week 1: General Overview Of ML And DL Applications In Agriculture

Week 2: Basics Of Multivariate Data Analytics

Week 3: Principal Component Analysis And Regression Applications In Agriculture

Week 4: Applications Of Classification And Clustering Methods In Agriculture

Week 5: Diffuse Reflectance Spectroscopy: Basics And Applications For Crop And Soil

Week 6: Use Of ML For Portable Proximal Soil And Crop Sensors

Week 7: ML And DL For Soil And Crop Image Processing

Week 8: UAV And ML Applications In Agriculture

Week 9: Hyperspectral Remote Sensing And ML Applications In Agriculture

Week 10: Digital Soil Mapping – General Overview

Week 11: Digital Soil Mapping With Continuous Variables

Week 12: Digital Soil Mapping With Categorical Variables



MARKETING MANAGEMENT - II

PROF. JAYANTA CHATTERJEE

Department of Industrial and Management Engineering
IIT Kanpur

PROF. SHASHI SHEKHAR

Department of Industrial and Management Engineering
IIT Kanpur

INDUSTRY SUPPORT: FMCG, Automotive, Chemical, Pharmaceutical, Engineering and Service Industries

PRE-REQUISITES : Graduation, Marketing Management-I

INTENDED AUDIENCE : BE/ME/BBA/MBA

COURSE OUTLINE :

This is part-II of a course on Marketing Management. The objective of the course is to introduce the participants to principles and practices, theoretical building blocks of marketing, its role as an organizational engine and the evolving marketing process of today. At the end of the course, a participant will be able to understand and manage the core marketing management function.

ABOUT INSTRUCTOR :

Prof. Jayanta Chatterjee is an Adjunct Senior Professor of Marketing, Sales and Strategy in the Department of Industrial and Management Engineering at IIT Kanpur. An Electrical Engineering graduate from Jadavpur University, M.Tech and PhD from IIT Delhi. Prof. Chatterjee has eighteen years of Management teaching experience in India and abroad and 30 years of hands on management experience in different countries. He has risen through Sales, Marketing, Project Management, Technology and Business development functions in top multinationals like Siemens, Allen Bradley, and Rockwell International to CEO and Executive Director positions. He has founded two successful start-ups and mentored many. His earlier courses on Marketing Management I and II, Strategic marketing and Managing Services on NPTEL are well subscribed. The book on Services marketing co-authored by Prof Chatterjee and published by Pearson India is also well known.

Prof. Shashi Shekhar Mishra is currently working as Assistant Professor in the Department of Industrial and Management Engineering at Indian Institute of Technology Kanpur since December 2011. Dr. Mishra has received his PhD (Marketing) from Indian Institute of Management, Lucknow. He holds an Engineering degree in chemical technology from H.B.T.I. Kanpur, and has worked for three years in petrochemical and automobile industry before joining the doctoral program at IIM Lucknow. He has professional experience in the area of Product Management, Technology Strategy, and Business-to-Business marketing. With more than eight years of industrial, teaching, research, training and consulting experience, Dr. Mishra has several research publications in internationally acclaimed journals and conferences. His research interest include: New Product Development, Marketing Strategy, High-technology Product Marketing, and Advanced Marketing Research & Analytics.

COURSE PLAN

Week 1 : Design, Launch, & Management of Market Offerings

Week 2 : Design, Launch, & Management of Market Offerings - contd

Week 3 : Services Marketing

Week 4 : Brand Management

Week 5 : Brand Management - contd

Week 6 : Design and Implementation of Pricing Strategies

Week 7 : Marketing Channels and Distribution System

Week 8 : Integrated Marketing Communication



MARKETING RESEARCH AND ANALYSIS

PROF. J.K. NAYAK

Department of Management
IIT Roorkee

INTENDED AUDIENCE : Corporate executives, U.G, P.G and PhD students from the management discipline. It is a core as well as elective course for UG and PG.

INDUSTRIES APPLICABLE TO : All Industries both in Public and Private space, academic institutions and Research organizations

COURSE OUTLINE :

Marketing research is involved with the linking of the manufacturers, intermediaries and the customers through information. It helps in identifying the recent trends in habits and behaviours of consumers through a research process. Some of the key applications of this study is to create a better product, decide the right price, distribution system and the promotional mechanism to attract customers and make a difference within the competition. It uses research tools in understanding the customer and segmenting the market. Some of the research tools are qualitative and quantitative in nature as well. Some of the frequently used techniques are like focus group study, TAT, projective techniques, regression analysis, factor and cluster analysis, discriminant analysis, structural equation modeling, multidimensional scaling and conjoint analysis etc. and other multivariate techniques.

ABOUT INSTRUCTOR :

Prof. Jogendra Kumar Nayak is the Associate Professor in Marketing in the Department of Management Studies, Indian Institute of Technology Roorkee. He is a Ph.D. degree holder from the Indian Institute of Technology Kharagpur. He teaches marketing research in both spring and autumn semesters in IIT Roorkee. Along with it, he also teaches industrial marketing. He also stands credited for authoring a book on Retail Management which has been published by a reputed publishing house like Cengage. He has publications in most of the publishing houses such as Elsevier, Emerald, Sage and Taylor and Francis. His major research areas are Industrial Marketing, Consumer Behavior, and Tourism Management. He regularly conducts a workshop titled "Data Analysis for Research and Publication" which is attended by participants from educational institutes, Govt. organizations and industry as well.

COURSE PLAN :

Week 1: Introduction to Marketing Research, Defining Research Problem, Developing, Research Approach, Research Design, Qualitative Research.

Week 2: Qualitative Research, Projective Technique, Case Study, Descriptive Research, Design, Primary & Secondary Data, Research Error, Measurement & Scaling.

Week 3: Scale Development, Questionnaire & Form Design, Causal Research, Experimental Design & Sampling.

Week 4: Sampling, Hypothesis Development, Type I & Type II Errors, Data Preparation, Hypothesis Testing.

Week 5: Hypothesis Testing, Cross Tabulation, Correlation & Regression, Factor Analysis.

Week 6: Factor Analysis, SEM & CFA, Cluster Analysis.

Week 7: Cluster Analysis, Discriminant Analysis, Researching Rural Market, International Marketing Research.

Week 8: Ethics, Report Preparation, Multi Dimensional Scaling, Conjoint Analysis.



MATLAB PROGRAMMING FOR NUMERICAL COMPUTATION

PROF. NIKET KAISARE

Department of Chemical Engineering
IIT Madras

INTENDED AUDIENCE

This is an introductory course, targeted towards scientists and engineers interested in using MATLAB programming for numerical computations. Examples taken in this course will be of generic interest to a wide range of students. This is a hands-on (like a laboratory) elective course. Intended audience include undergraduates, people with BE / ME / MS / MSc degrees; The course may be useful for PhD students also.

PRE-REQUISITES

The students for this course are expected to know basics of linear algebra and calculus, at 12th standard level. These are also covered in Introductory Math course for Engineers (typically done in first year).

This course is intended to be practical (laboratory) course. Some prior background in programming will be useful, though not required. Likewise, students who have either completed or are currently doing “Numerical Methods” / “Computational Techniques” will find it easier to follow this course. Theoretical aspects of methods covered in this lab can be found in NPTEL course on "Numerical Methods for Engineers" (<https://nptel.ac.in/courses/127106019>).

ABOUT THE COURSE

MATLAB is a popular language for numerical computation. This course introduces students to MATLAB programming, and demonstrate its use for scientific computations. The basis of computational techniques are expounded through various coding examples and problems, and practical ways to use MATLAB will be discussed. By the end of this course, students would:

1. Learn basics of MATLAB programming
2. Get introduced to numerical methods for engineering problems
3. Will be able to use MATLAB to solve computational problems

SOFTWARE USED:

We will use MATLAB in this course. Course lectures, practice problems and assignments will use MATLAB.

MATLAB Online is a fully-featured browser-based version of MATLAB. With support from MathWorks, access to MATLAB Online is provided free-of-cost to all the enrolled students for the duration of this course.

ABOUT THE COURSE:

Prof. Niket Kaisare is a Professor of Chemical Engineering in IIT-Madras. He works in the area of modeling, design and control for energy applications. He has over ten years of research/teaching experience in academia, and three-year experience in Industrial R&D. He uses computational software, including MATLAB, FORTRAN, Aspen and FLUENT extensively in his research and teaching.

Faculty web-page: <http://www.che.iitm.ac.in/~nkaisare/>

COURSE PLAN:

The course will be covered in twelve modules. Various aspects of MATLAB programming for numerical computation will be covered in these modules, with each module dedicated to an equivalent numerical topic. There will be self-study problems and graded assignment problems given each week, which are to be solved using MATLAB. The course plan is:

1. Introduction to MATLAB Programming: This module will introduce the students to MATLAB programming through a few examples. Students who have used MATLAB are still recommended to do this module, as it introduces MATLAB in context of how we use it in this course
2. Building your Code with MATLAB: This module covers MATLAB Script and Function files, loops, execution control, best-practices for MATLAB functions and tips on how to debug a MATLAB code.
3. Approximations and Errors: Taylor's / Maclaurin series expansion of some functions will be used to introduce approximations and errors in computational methods
4. Linear Equations: The focus of this module is to do a quick introduction of most popular numerical methods in linear algebra, and use of MATLAB to solve practical problems.
5. Nonlinear Equations: After introduction to bisection rule, this module primarily covers Newton-Raphson method and MATLAB routines `fzero` and `fsolve`.
6. Numerical Differentiation and Integration: Methods of numerical differentiation and integration, trade-off between truncation and round-off errors, error propagation and MATLAB functions for integration will be discussed.
7. Ordinary Differential Equations (ODE): Explicit ODE solving techniques in single variable will be covered in this module.
8. ODE-IVP in Multiple Variables: This module will cover ODE solving in multiple variables, stiff systems, and practical problems. The importance of ODEs in engineering is reflected by the fact that two modules are dedicated to ODEs.
9. Regression and Interpolation: The focus will be practical ways of using linear and nonlinear regression and interpolation functions in MATLAB.
10. ODE-BVP and DAE: ODE-Boundary Value Problems; Differential Algebraic Equations
11. Partial Differential Equations (PDEs): Practical ways of solving Hyperbolic and Parabolic PDEs
12. Bringing it all together: Optimization and Solving interesting computational problems by bringing together multiple concepts



MATLAB-BASED PROGRAMMING LAB IN CHEMICAL ENGINEERING

PROF. PARAG A. DESHPANDE

Department of Chemical Engineering
IIT Kharagpur

PRE-REQUISITES : The students should ideally be in the 3rd/4th year of their undergraduate degree who have had courses on fluid mechanics, reaction engineering, heat transfer and mass transfer

INTENDED AUDIENCE : - Undergraduate students of chemical engineering

- University/college faculty

COURSE OUTLINE :

This is computer lab course for the undergraduate students of chemical engineering. We will be using MATLAB as the language for solving chemical engineering problems which the students encounter not only in their undergraduate curriculum but are also relevant and important in process industries. The course will impart the not only MATLAB programming skills but also the skills on problem analysis, solution, interpretation and presentation of results.

ABOUT INSTRUCTOR :

Prof.Parag A. Deshpande is a professor of chemical engineering at the Indian Institute of Technology Jodhpur. He received his doctoral degree from the Indian Institute of Science Bangalore, graduating as the recipient of the best thesis of the year award in the department of chemical engineering. He joined IIT Kharagpur in 2012. His research interests include computational analysis of catalytic and biocatalytic systems. He has taught several courses at IIT Kharagpur to undergraduate, masters and doctoral students including advanced mathematical techniques, chemical and statistical thermodynamics, classical and quantum methods in molecular simulations, and process dynamics.

COURSE PLAN :

Week 1:

Lecture 1: Motivation for the lab course

Lecture 2: Analysis of situations in process industries which mandate the use of computers

Lecture 3: Analysis of situations in process industries which mandate the use of computers continued

Lecture 4: Discussion on computational tools available to chemical engineers

Lecture 5: Analysis and comparison of different programming languages for solving chemical engineering problems

Week 2:

Lecture 6: MATLAB primer - basic features

Lecture 7: MATLAB primer - Writing codes

Lecture 8: MATLAB primer - coding continued

Lecture 9: MATLAB primer - coding continued

Lecture 10: MATLAB primer - Plotting and presentation of results

Week 3:

Lecture 11: Lab 1 - Analysis of frictional losses in pipe flows; problem definition and analysis

Lecture 12: Lab 1 - Theory and solution strategy

Lecture 13: Lab 1 - Solution of the problem under various conditions

Lecture 14: Lab 1 - Solution of the problem under various conditions continued

Lecture 15: Lab 1 - Presentation and interpretation of results

Week 4:

Lecture 16: Lab 2 - Steady-state analysis of diabatic operation of a CSTR; problem definition and analysis

Lecture 17: Lab 2 - Theory and solution strategy

Lecture 18: Lab 2 - Solution of the problem under various conditions

Lecture 19: Lab 2- Solution of the problem under various conditions continued

Lecture 20: Lab 2 - Presentation and interpretation of results

Week 5:

Lecture 21: Lab 3 - Analysis of multicomponent distillation; problem definition and analysis

Lecture 22: Lab 3 - Theory and solution strategy

Lecture 23: Lab 3 - Solution of the problem under various conditions

Lecture 24: Lab 3 - Solution of the problem under various conditions continued

Lecture 25: Lab 3 - Presentation and interpretation of results

Week 6:

Lecture 26: Lab 4 – Analysis of cooling of a solid body in a reservoir; problem definition and analysis
Lecture 27: Lab 4 – Theory and solution strategy
Lecture 28: Lab 4 – Solution of the problem under various conditions
Lecture 29: Lab 4 – Solution of the problem under various conditions continued
Lecture 30: Lab 4 – Presentation and interpretation of results

Week 7:

Lecture 31: Lab 5 – Analysis of unsteady-state operation of a cascade CSTR system; problem definition and analysis
Lecture 32: Lab 5 – Theory and solution strategy
Lecture 33: Lab 5 – Solution of the problem under various conditions
Lecture 34: Lab 5 – Solution of the problem under various conditions continued
Lecture 35: Lab 5 – Presentation and interpretation of results

Week 8:

Lecture 36: Lab 6 – Analysis of steady-state heat conduction in a one dimensional rod; problem definition and analysis
Lecture 37: Lab 6 – Theory and solution strategy
Lecture 38: Lab 6 – Solution of the problem under various conditions
Lecture 39: Lab 6 – Solution of the problem under various conditions continued
Lecture 40: Lab 6 – Presentation and interpretation of results

Week 9:

Lecture 41: Lab 7 – Analysis of reaction-diffusion in a catalyst pore; problem definition and analysis
Lecture 42: Lab 7 – Theory and solution strategy
Lecture 43: Lab 7 – Solution of the problem under various conditions
Lecture 44: Lab 7 – Solution of the problem under various conditions continued
Lecture 45: Lab 7 – Presentation and interpretation of results

Week 10:

Lecture 46: Lab 8 – Analysis of steady-state heat conduction problem in two and three-dimensions; problem definition and analysis
Lecture 47: Lab 8 – Theory and solution strategy
Lecture 48: Lab 8 – Solution of the problem under various conditions
Lecture 49: Lab 8 – Solution of the problem under various conditions continued
Lecture 50: Lab 8 – Presentation and interpretation of results

Week 11:

Lecture 51: Lab 11 – Process economics and optimisation; problem definition and analysis
Lecture 52: Lab 9 – Theory and solution strategy
Lecture 53: Lab 9 – Solution of the problem under various conditions
Lecture 54: Lab 9 – Solution of the problem under various conditions continued
Lecture 55: Lab 9 – Presentation and interpretation of results

Week 12:

Lecture 56: Lab 12 – Regression and curve-fitting of data; problem definition and analysis
Lecture 57: Lab 10 – Theory and solution strategy
Lecture 58: Lab 10 – Solution of the problem under various conditions
Lecture 59: Lab 10 – Solution of the problem under various conditions continued
Lecture 60: Review of the course



METAL ADDITIVE MANUFACTURING

PROF. JANAKRANJAN RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH OBEROI

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRY SUPPORT : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

The manufacturing technology has advanced greatly in the recent years with Additive Manufacturing (AM) of metals now being extended to all sectors of industry such as aerospace, medical, and tooling. The fourth industrial revolution with the advent of IoT and digital manufacturing demands for quicker and modular manufacturing solutions which are well catered by metal AM Technologies. This course brings the introduction to the current status of metal AM basics, materials, processes, and major important related aspects to the table. The students, teachers, practitioners would benefit from this course in updating their skills in the modern technology. The course is supplemented with laboratory demonstrations practical experience. After completion of the course, the learners would be able to advance their prowess in AM in order to reduce the cost of production, improve the performance of fabricated parts, and achieve their defined targets in metal products manufacturing.

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 200 journal papers.

Prof. Amandeep Singh Oberoi is a Faculty for online courses and shoulders the position of Senior Research Establishment Officer at the prestigious Indian Institute of Technology (IIT) Kanpur, India. Under the role, he is entrusted with the responsibility to manage Imagineering Laboratory, where the emphasis is principally given to providing novel product development and fostering services in defense, Agritech, and Medtech. Dr. Oberoi has accumulated an experience of over two decades: industrial and academic combined; his research interests include the things he values such as Sustainable Manufacturing Processes and Systems, along with areas such as Additive Manufacturing; Simulation of Manufacturing Systems; Product Design and Manufacturing. He has fetched grants and has holds projects from various national and international funding agencies such as DST, MoT, BIRAC, DRDO, SIDBI, CoL. His MOOCs courses in NPTEL and agMOOC are well-received, gaining favour with the audience and receiving positive feedback. Furthermore, he has visited countries like the USA, Canada, Australia, and Egypt to speak at various international symposiums organised by renowned bodies such as AARDO, CIRP, IEOM.

COURSE PLAN :

Week 1: Introduction to Additive Manufacturing (AM)

Week 2: Modular Design and Topology

Week 3: Design freedom in AM

Week 4: CAD for AM

Week 5: Metal AM physics and processes, Laser and Extrusion

Week 6: Metal AM processes, Filament, Powder and Sheet Systems

Week 7: Metal AM physics and processes, Directed Energy, Binder and Material Jetting

Week 8: Feedstocks, metallurgy and properties of materials

Week 9: Post processing and testing

Week 10: Reverse Engineering for metal AM

Week 11: Modelling for AM

Week 12: Value analysis, and future of metal AM



MICROFLUIDICS AND NANOFUIDICS

PROF. SUMAN CHAKRABORTY

Department of Mechanical Engineering
IIT Kharagpur

PRE-REQUISITES : Mathematics at plus-two level

INTENDED AUDIENCE : B. Tech/M. Tech/MS/B.Sc./M.Sc./PhD students of all disciplines and medical professionals with a prior background of mathematics are eligible to take this course

COURSE OUTLINE :

This is a basic course in Microfluidics and Nanofluidics intended for students at both undergraduate and postgraduate level as well as Industry and Medical Professionals. This course starts with an emphasis on the application perspectives of the topic. Subsequently, it provides a lucid mathematical treatment to the subject, with simple experimental demonstrations of the discussed theory. After completion of this course, the students will have a deep understanding of the fundamental as well as applied perspectives of the subject, with a unique balance between theory and practice, and will be in a position to address challenging R&D problems in applied sciences related to microsystems and nanoengineering and medical technology.

ABOUT INSTRUCTOR :

Prof. Suman Chakraborty is currently a Professor in the Mechanical Engineering Department as well as an Institute Chair Professor of the Indian Institute of Technology Kharagpur, India, and the Head of the eSchool of Medical Science and Technology. He is also the Associate Dean for Sponsored Research and Industrial Consultancy. His current areas of research include microfluidics, nanofluidics, micro-nano scale transport, with particular focus on biomedical applications. He has been awarded the Santi Swaroop Bhatnagar Prize in the year 2013, which is the highest Scientific Award from the Government of India. He has been elected as a Fellow of the American Physical Society, Fellow of the Royal Society of Chemistry, Fellow of ASME, Fellow of all the Indian National Academies of Science and Engineering, recipient of the Indo-US Research Fellowship, Scopus Young Scientist Award for high citation of his research in scientific/technical journals, and Young Scientist/ Young Engineer Awards from various National Academies of Science and Engineering. He has also been an Alexander von Humboldt Fellow, and a visiting Professor at the Stanford University. He has 380+ Journal publications.

COURSE PLAN :

Week 1: Introduction to Microfluidics

Week 2: Introduction to Microfluidics

Week 3: Foundations of Fluid Dynamics

Week 4: Foundations of Fluid Dynamics

Week 5: Pressure-driven Microchannel Flows

Week 6: Inertia-free Flows, and Microelectric Fluid Flow through Microchannel

Week 7: Fluid Flow through Deformable Microchannels, and Lubrication Theory

Week 8: Lubrication Theory, and Unsteady Flows

Week 9: Unsteady Flows: Stoke's 1st and 2nd Problem, and Stokes Flow Past a Sphere

Week 10: Surface Tension, Equilibrium of a Droplet, and Capillary Filling Dynamics

Week 11: Capillary Filling Dynamics, Electrowetting, Slip Boundary Condition, and Thin Film Flows

Week 12: Thin Film Flows, and Electrokinetics



OPTICAL WIRELESS COMMUNICATIONS FOR BEYOND 5G NETWORKS AND IOT

PROF. ANAND SRIVASTAVA

Department of Electronics and Communication Engineering
IIIT Delhi

PRE-REQUISITES : Signals and Systems

INDUSTRY SUPPORT : Sterlite Technologies Ltd., Tejas Networks, BSNL - other Telecom companies, BEL, ITI etc

COURSE OUTLINE :

Optical Wireless Communications (OWC) has become a promising technology for supporting high-data-rate 5G communication and the massive connectivity of IoT. This course broadly covers the four important aspects of OWC systems: (a) the fundamental principles of OWC, (b) devices and systems, (c) modulation techniques and (d) channel models and system performance analysis. The course also covers different challenges encountered in OWCs as well as outlining possible solutions and current research trends. The course will also involve MATLAB® simulations to help students understand the topic under discussion and to be able to carry out extensive simulations.

ABOUT INSTRUCTOR :

Prof. ANAND SRIVASTAVA has done M.Tech. and Ph.D. from IIT Delhi. Before joining IIIT Delhi, he was Dean & Professor in School of Computing and Electrical Engineering at Indian Institute of Technology Mandi, HP, India and also Adjunct faculty at IIT Delhi. Prior to this, he was with Alcatel-Lucent-Bell Labs, India as solution architect for access and core networks. Before joining Alcatel Lucent, he had a long stint (~ 20 years) with Center for Development of Telematics (CDOT), a telecom research center of Govt. of India where he was Director and member of CDOT Board. During his stay in CDOT, he provided technical leadership and motivation to extremely qualified team of engineers engaged in the development of national level projects in the areas of Telecom Security Systems, Network Management System, Intelligent Networks, Operations Support Systems, Access Networks (GPON) and Optical Technology based products. Majority of these projects were completed successfully and commercially deployed in the public network. He was also closely involved with ITU-T, Geneva in Study Group 15 and represented India for various optical networking standards meetings. His research work is in the area of optical core and access networks, Vehicle to vehicle communications, Fiber-Wireless (FiWi) architectures, optical signal processing, and Visible Light Communications. He has published over 100 papers in peer reviewed journals and conferences.

COURSE PLAN :

Week 1: Introduction: Optical Wireless Communication Systems

Week 2: Optical Sources

Week 3: Detectors

Week 4: Indoor Optical Wireless Communication Channel Modelling

Week 5: Outdoor Optical Wireless Communication Channel Modelling

Week 6: Modulation Schemes

Week 7: System Performance Analysis: Indoor OWC links

Week 8: System Performance Analysis: Outdoor OWC links

Week 9: Hybrid RF/FSO Communications

Week 10: Visible Light Communications (VLC)

Week 11: MIMO in OWC

Week 12: Standardization in OWC



PATENT DRAFTING FOR BEGINNERS

PROF. FEROZ ALI

Department of Management Studies

IIT Madras

INDUSTRIES APPLICABLE TO : Law Firms, LPOs, knowledge-based industries etc

INTENDED AUDIENCE : Anyone interested in patent drafting

PRE-REQUISITES : No pre-requisites for this course. But students may benefit from the course "Patent Law For Engineers and Scientists"

COURSE OUTLINE :

Patent specifications — the documents which encompass the patent right in a technological invention are techno-legal documents created at the interface of science and law. Unlike technical writing, patent law requires drafting patent specifications to satisfy certain requirements. This course is designed to enable beginners without any prior knowledge on patent drafting to draft patent specifications on their own. The course will cover the fundamental principles of patent drafting and discuss in detail the concepts in patent law in the context of patent drafting.

ABOUT INSTRUCTOR :

Prof. Feroz Ali is the Chair Professor on Intellectual Property Rights (IPR) at the Indian Institute of Technology (IIT) Madras. He teaches intellectual property laws and business laws. He is the author of three books on patent law. He is a practicing advocate at the Madras High Court. He litigates and counsels in intellectual property law, corporate law and competition law but his primary focus has remained in patent law. He has appeared before the Supreme Court, the High Courts, Intellectual Property Appellate Board and the Patent Offices

COURSE PLAN :

Week 1 : Invention as a solution to an unsolved Problem

Week 2 : Drafting a Claim

Week 3 : Types and Arrangement of Claims

Week 4 : Structure of the Patent Specification



PETROLEUM TECHNOLOGY

PROF. SONALI SENGUPTA

Department of Chemical Engineering
IIT Kharagpur

INTENDED AUDIENCE : Students from B.Tech or M.Tech in Chemical Engineering, Chemical Technology or Petroleum Engineering

INDUSTRY SUPPORT : Any companies / industries related to crude petroleum/petroleum products processing, refineries.

COURSE OUTLINE :

Petroleum technology course will cover a broad area to introduce the Chemical Engineering and Petroleum Engineering UG/PG students about the storage of crude petroleum in underground and its recovery, crude oil evaluation, its processing to get various valuable petroleum products. Moreover, in these lecture videos I am going to discuss and illustrate different techniques, processes and tools that will allow to grasp a detail view of the steps associated with petroleum processing to meet the Indian Standard Specifications as well as market demand.

ABOUT INSTRUCTOR :

Prof. Sonali Sengupta is the faculty of Department of Chemical Engineering, Indian Institute of Technology Kharagpur from last nineteen years. She mainly teaches Fuel Technology, Chemical Reaction Engineering, Heterogeneous Catalysis etc in UG and PG level. Her research field is reaction engineering and catalysis, purification treatment of petroleum fuels, waste water treatment by adsorption, photocatalysis and electrocatalysis etc. She has quite a good number of national and international journal and conference publications.

COURSE PLAN :

Week 1: Overview of Petroleum : History, recovery and evaluation of crude petroleum

Week 2: Primary processing of crude oil

Week 3: Secondary processing of petroleum fractions

Week 4: Properties and testing of crude petroleum and petroleum products

Week 5: Introduction and properties of straight-run cuts from distillation units

Week 6: Upgradation of straightrun cuts from atmospheric distillation units

Week 7: Purification processes

Week 8: Fundamental of thermochemistry



POWER QUALITY

PROF. BHIM SINGH

Department of Electrical Engineering
IIT Delhi

PRE-REQUISITES : Circuit and Networks, Basic Electrical Engineering, Power Electronics, Power System, and Linear Control System

INTENDED AUDIENCE : Primarily the graduate students working in the area of energy economics and energy policy domain. This course will also be useful for general audience

INDUSTRIES APPLICABLE TO : ABB Group, Schneider Electric, General Electric (GE), Siemens, Captech, Electrical India

COURSE OUTLINE :

This course is intended to provide tools to classify, quantify, and analyze the power quality problems and to provide practical engineering solutions to mitigate these problems. The objectives of this course are as follows.

- To understand the various power quality issues.
- To understand the concept of power and power factor in single-phase and three-phase systems supplying nonlinear loads.
- To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
- To understand the active compensation techniques used for reactive power compensation, load balancing, power factor correction, and load voltage regulation.
- To understand the active filter techniques used for harmonics elimination.
- To understand the power quality improvement in SMPS, drive systems, and renewable energy systems.

ABOUT INSTRUCTOR :

Prof. Bhim Singh has received his B.E. (Electrical) from the University of Roorkee, India, in 1977 and his M.Tech. (Power Apparatus & Systems) and Ph.D. from the Indian Institute of Technology Delhi, India, in 1979 and 1983, respectively. In 1983, he joined the Department of Electrical Engineering, University of Roorkee (Now IIT Roorkee), as a Lecturer. He became a Reader there in 1988. In December 1990, he joined the Department of Electrical Engineering, IIT Delhi, India, as an Assistant Professor, where he has become an Associate Professor in 1994 and a Professor in 1997. He has been ABB Chair Professor from September 2007 to September 2012. He has also been CEA Chair Professor from October 2012 to September 2017. He has been Head of the Department of Electrical Engineering at IIT Delhi from July 2014 to August 2016. He has been the Dean, Academics at IIT Delhi from August 2016 to August 2019. He is JC Bose Fellow of DST, Government of India since December 2015. Prof. Singh is the Chairman of BOG, Maulana Azad National Institute of Technology, Bhopal, since 3rd July 2018 for 3 Years and Nonofficial Independent Director, NTPC Limited, since 17th July 2018 for 3 Years. He is CEA Chair Professor since January 2019. Prof. Singh is also member of Governing Council of Central Power Research Institute. Prof. Singh has guided 95 Ph.D. dissertations, and 168 M.E./M.Tech./M.S.(R) theses. He has been filed 69 patents. He has executed more than eighty sponsored and consultancy projects. He has co-authored a text book on power quality: Power Quality Problems and Mitigation Techniques published by John Wiley & Sons Ltd. 2015. In his academic career, he published 961 journal papers in reputed international and national journals and 1382 conference papers in various international and national conferences. His areas of interest include grid-interfaced solar photovoltaic system, solar water pumping system, solar lighting system, renewable energy source based microgrid, electric vehicle charging infrastructure, designing of the high efficient motor for the electric vehicle, designing of the high power charger for the electric vehicle, power quality monitoring and mitigation improved power quality AC-DC converters, power electronics, electrical machines, drives, flexible alternating transmission systems, and high voltage direct current systems. Prof. Singh is a Fellow of the Indian National Academy of Engineering (FNAE), The Indian National Science Academy (FNA), The National Academy of Science, India (FNASc), The Indian Academy of Sciences, India (FASc), The World Academy of Sciences (FTWAS), Institute of Electrical and Electronics Engineers (FIEEE), the Institute of Engineering and Technology (FIET), Institution of Engineers (India) (FIE), and Institution of Electronics and Telecommunication Engineers (FIETE) and a Life Member of the Indian Society for Technical Education (ISTE), System Society of India (SSI), and National Institution of Quality and Reliability (NIQR).

He has received Khosla Research Prize of University of Roorkee in the year 1991. He is recipient of JC Bose and Bimal K Bose awards of The Institution of Electronics and Telecommunication Engineers (IETE) for his contribution in the field of Power Electronics. He is also a recipient of Maharashtra State National Award of Indian Society for Technical Education (ISTE) in recognition of his outstanding research work in the area of Power Quality. He has received PES Delhi Chapter Outstanding Engineer Award for the year 2006. Professor Singh has received Khosla National Research Award of IIT Roorkee in the year 2013. He is a recipient of Shri Om Prakash Bhasin Award-2014 in the field of Engineering including Energy & Aerospace. Professor Singh has received IEEE PES Nari Hingorani Custom Power Award-2017. He is also a recipient of "Faculty Research Award as a Most Outstanding Researcher" in the field of Engineering-2018 of Careers 360, India. He has received Faculty Lifetime Research Award-2018 for overall research contribution at IIT Delhi. He is recipient IEEE-IAS outstanding educator/mentor award 2020. Prof. Singh is also the recipient of INAE outstanding teaching award 2020 and Eminent Engineer Award-2020 from Institution of Engineers (India). Prof. Bhim Singh is the recipient of the first International Solar Alliance (ISA)- Haryana Kalpana Chawla Solar Award for working towards developing solutions in the Solar Energy Sector to help create a sustainable and low-carbon world for generations to come. He has been very active in professional societies such as the Institute of Electrical and Electronics Engineers (IEEE). He has been the Chairman of IEEE PES-IAS Delhi Joint Chapter for the last four years and during this period this chapter won twice the Outstanding Chapter Award, High-Performance Chapter Award every year, and one of best-performing chapter awards of last decade. He has been founder Chairman of IEEE PELS-IES Delhi Joint Chapter and its Chairman since 2006. He is a Distinguished Lecturer (DL) of IEEE Power and Energy Society under the Distinguished Lecture of Program (DLP) of IEEE since the year 2002. He has been the General Chair of the 2006 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES'2006), General Co-Chair of the 2010 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES'2010), General Co-Chair of the 2015 IEEE International Conference (INDICON'2015), General Co-Chair of 2016 IEEE International Conference (ICPS'2016) held in New Delhi, General Co-Chair of 2017 National Power Electronics Conference (NPEC) held in Pune. He has been as "Patron" of the IEEE 9th Power India International Conference (PIICON-2020), IEEE International Conference on Computing, Power and Communication Technologies (GUCON-2020), IEEE International Conference on Computing, Communication and Automation (ICCCA-2020), IEEE Indian Council International Conference (IEEE- INDICON 2020). He has been the "Member of Technical Advisory Committee" of the IEEE International conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE 2020), IEEE International Conference on Electrical and Electronics Engineering (ICE3-2020), IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON 2020), (4) National Power Systems Conference (NPSC 2020).

COURSE PLAN:

Week 1 : Power quality: An Introduction

Week 2 : Power quality standards and monitoring

Week 3 : Passive Shunt and Series Compensation

Week 4 : Active Shunt Compensation: DSTATCOM

Week 5 : Active Series Compensation: DVR

Week 6 : Unified Power Quality Compensators

Week 7 : Loads That Cause Power Quality Problems

Week 8 : Passive Power Filters

Week 9 : Shunt Active Power Filters

Week 10: Series Active Power Filters

Week 11: Hybrid Active Power Filters

Week 12: AC-DC Converters That Cause Power Quality Problems; Improved Power Quality Converters: AC-DC Converters; Improved Power Quality Converters; Power quality improvement in electrical system applications



PROBLEM SOLVING THROUGH PROGRAMMING IN C

PROF. ANUPAM BASU

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : BE/BTech in all disciplines BCA/MCA/M. Sc

INDUSTRIES APPLICABLE TO : All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Use arrays, pointers and structures to formulate algorithms and programs
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration

ABOUT INSTRUCTOR :

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing. Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN :

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching

Week 3: Conditional Branching and Iterative Loops

Week 4: Arranging things : Arrays

Week 5: 2-D arrays, Character Arrays and Strings

Week 6: Basic Algorithms including Numerical Algorithms

Week 7: Functions and Parameter Passing by Value

Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

Week 10: Structures and Pointers

Week 11: Self-Referential Structures and Introduction to Lists

Week 12: Advanced Topics



PRODUCT DESIGN AND DEVELOPMENT

PROF. INDERDEEP SINGH

Department of Mechanical and Industrial Engineering
IIT Roorkee

PRE - REQUISITES : Any student enrolled for a UG/PG degree in any discipline of humanities, management, science and engineering can complete the course.

INDUSTRY SUPPORT : All industries where products are being conceptualized, designed and developed in order to satisfy the human needs and requirements.

INTENDED AUDIENCE: It is a core course for UG and PG

COURSE OUTLINE :

It has been established worldwide that the most successful economies are based on innovation and creativity led entrepreneurship. The government is focusing on putting concerted efforts to produce job creators. The current MOOC on Product Design and Development is conceptualized and planned in such a way that it helps both job creators as well as job seekers. The main objective of the course is to acquaint the learners/students with the practical knowledge regarding conceptualization, design and development of a new product. The need of a new product, the product life cycle, the product design process, the application of Value Engineering principles in product design, various product design tools such as CAD, DFM, DFA and DFMA have been explained with relevant and specific examples/ case studies. The concept of Ergonomics in context of the product design has been explained with the help of case studies. The fundamental concept of Rapid Prototyping as well the working principles of the basic rapid prototyping techniques has also been explained.

ABOUT INSTRUCTOR :

Prof. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed three video and one web course under the National Programme on Technology Enhanced Learning (NPTEL). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

COURSE PLAN :

Week1: Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.

Week 2: Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

Week 3: Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design,.

Week 4: DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS



PRODUCT DESIGN AND MANUFACTURING

PROF. J. RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Innovation, better management, throughput improvements, and expansion of new technologies have led Product Design and Manufacturing as a compelling field for the students. Managing the product development process, right from idea generation to final product manufacturing has to be systematic and effective to meet the customer needs, while incorporating the time-to-market constraint as well. This course presents an overview of the product design and development process, along with the manufacturing systems aspects. The concepts Design for Manufacturing, Assembly, and Environment, and analytical tools for development, costing and manufacturing would help the students and practitioners learn to conceptualize, design, and manufacture competitively-priced quality products. Reverse Engineering, Prototyping and Simulation using soft tools are also incorporated make the students learn the advanced methods in manufacturing.

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers

Prof. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1: Introduction to product design and manufacturing

Week 2: Product design morphology

Week 3: Visual Design, and Quality Function Deployment (QFD)

Week 4: Value Engineering

Week 5: Material, and Manufacturing process selection

Week 6: Design for Manufacturing, Assembly, and Maintenance

Week 7: Design for Environment, and Quality Control

Week 8: Patenting, and Creativity

Week 9: Rapid Prototyping

Week 10: Plant Layout Design

Week 11: Computer Integrated Manufacturing

Week 12: Reverse Engineering, and Managing Competitiveness



PROGRAMMING IN JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

Week 7: Multithreaded Programming

Week 8: Java Applets and Servlets

Week 9: Java Swing and Abstract Windowing Toolkit (AWT)

Week 10: Networking with Java

Week 11: Java Object Database Connectivity (ODBC)

Week 12: Interface and Packages for Software Development



PROGRAMMING IN MODERN C++

PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Programming & Data Structure (mandatory), Programming in C (optional). Design and Analysis of Algorithms (optional)

INDUSTRIES APPLICABLE TO : Programming in C++ is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems) have a need for the same. These include –Microsoft, Samsung, Xerox, Yahoo, Oracle, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc. This course would help industry developers to be up-to-date with the advances in C++ so that they can remain at the state-of-the-art

COURSE OUTLINE :

There has been a continual debate on which programming language/s to learn, to use. As the latest TIOBE Programming Community Index for August 2021 indicates – C (13%), Python (12%), C++ (7%), Java (10%), and C#(5%) together control nearly half the programming activities worldwide. Further, C Programming Language Family (C, C++, C#, Objective C etc.) dominate more than 25% of activities. Hence, learning C++ is important as one learns about the entire family, about Object-Oriented Programming and gets a solid foundation to also migrate to Java and Python as needed. C++ is the mother of most general purpose of languages. It is multi-paradigm encompassing procedural, object-oriented, generic, and even functional programming. C++ has primarily been the systems language till C++03 which punches efficiency of the code with the efficacy of OOP. Then, why should I learn it if my primary focus is on applications? This is where the recent updates of C++, namely, C++11 and several later offer excellent depths and flexibility for C++ that no language can match. These extensions attempt to alleviate some of the long-standing shortcomings for C++ including porous resource management, error-prone pointer handling, expression semantics, and better readability. The present course builds up on the knowledge of C programming and basic data structure (array, list, stack, queue etc.) to create a strong familiarity with C++98 / C++03. Besides the constructs, syntax and semantics of C++ (over C), we also focus on various idioms of C++ and attempt to go to depth with every C++ feature justifying and illustrating them with several examples and assignment problems. On the way, we illustrate various OOP concepts. The course also covers important advances in C++11 and later released features

ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (<https://www.facebook.com/t10kt.algorithms/>) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

COURSE PLAN:

Week 1: Programming in C++ is Fun.

Week 2: C++ as Better C.

Week 3: OOP in C++.

Week 4: OOP in C++.

Week 5: Inheritance.

Week 6: Polymorphism.

Week 7: Type Casting.

Week 8: Exceptions and Templates.

Week 9: Streams and STL.

Week 10: Modern C++.

Week 11: Lambda and Concurrency.

Week 12: Move, Rvalue and STL Containers.



PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE : Students in any branch of mathematics/science/engineering, 1st year

PRE-REQUISITES : School level mathematics.

INDUSTRIES APPLICABLE TO : This course should be of value to any company requiring programming skills.

COURSE OUTLINE :

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

COURSE PLAN:**Week 1:**

Informal introduction to programming, algorithms and data structures

Downloading and installing Python

gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions

Week 2:

Python: types, expressions, strings, lists, tuples

Python memory model: names, mutable and immutable values

List operations: slices etc

Binary search

Inductive function definitions: numerical and structural induction

Elementary inductive sorting: selection and insertion sort

In-place sorting

Week 3:

Basic algorithmic analysis: input size, asymptotic complexity, $O()$ notation

Arrays vs lists

Merge sort

Quicksort

Stable sorting

Week 4:

Dictionaries

More on Python functions: optional arguments, default values

Passing functions as arguments

Higher order functions on lists: map, iter, list comprehension

Week 5:

Exception handling

Basic input/output

Handling files

String processing

Week 6:

Backtracking: N Queens, recording all solutions

Scope in Python: local, global, nonlocal names

Nested functions

Data structures: stack, queue

Heaps

Week 7:

Abstract datatypes

Classes and objects in Python

"Linked" lists: find, insert, delete

Binary search trees: find, insert, delete

Height-balanced binary search trees

Week 8:

Efficient evaluation of recursive definitions: memoization

Dynamic programming: examples

Other programming languages: C and manual memory management

Other programming paradigms: functional programming



PYTHON FOR DATA SCIENCE

PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PRE-REQUISITES : Knowledge of basic data science algorithms

INTENDED AUDIENCE : Final Year Undergraduates

COURSE OUTLINE :

The course aims at equipping participants to be able to use python programming for solving data science problems

ABOUT INSTRUCTOR :

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

COURSE PLAN :**Week 1:****BASICS OF PYTHON SPYDER (TOOL)**

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

Week 2:**Sequence data types and associated operations**

- Strings
- Lists
- Arrays
- Tuples
- Dictionary
- Sets
- Range

NumPy

- ndArray

Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

Data visualization on Toyota Corolla dataset using matplotlib and seaborn libraries

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

Control structures using Toyota Corolla dataset

1. if-else family
2. for loop
3. for loop with if break
4. while loop
5. Functions

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income



RAPID MANUFACTURING

PROF. JANAKARAJAN RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH OBEROI

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program

INTENDED AUDIENCE : Students of all Engineering and Science disciplines

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

In the contemporary dynamic manufacturing era, to produce products that can be easily made and can offer typical competences is of utmost importance. Besides basic manufacturing processes, engineering students and manufacturers need to bolster their skills in advanced technologies. This course is a step in this direction to make the students learn design, development, and manufacturing using Rapid Manufacturing technologies. Along with specific Rapid Prototyping techniques, manufacturing concerns such as geometric modelling, design for manufacturing and assembly, developing modular designs, group technology, et cetera are included. Laboratory demonstrations are also induced for practical experience. In the end of this course, students should be able to identify the methods and techniques required to manufacture any model.

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers.

Prof. Amandeep Singh Oberoi is a Faculty for online courses and shoulders the position of Senior Research Establishment Officer at the prestigious Indian Institute of Technology (IIT) Kanpur, India. Under the role, he is entrusted with the responsibility to manage Imagineering Laboratory, where the emphasis is principally given to providing novel product development and fostering services in defense, Agritech, and Medtech. Dr. Oberoi has accumulated an experience of over two decades: industrial and academic combined; his research interests include the things he values such as Sustainable Manufacturing Processes and Systems, along with areas such as Additive Manufacturing; Simulation of Manufacturing Systems; Product Design and Manufacturing. He has fetched grants and has holds projects from various national and international funding agencies such as DST, MoT, BIRAC, DRDO, SIDBI, CoL. His MOOCs courses in NPTEL and agMOOC are well-received, gaining favour with the audience and receiving positive feedback. Furthermore, he has visited countries like the USA, Canada, Australia, and Egypt to speak at various international symposiums organised by renowned bodies such as AARDO, CIRP, IEOM.

COURSE PLAN :

Week 1 : Introduction to Rapid Manufacturing (RM)

Week 2 : Product Design Process

Week 3 : Design for Modularity

Week 4 : Reverse Engineering

Week 5 : 3D measurement: laboratory demonstration

Week 6 : Polymerization, and Powder based RM processes

Week 7 : Liquid based, and Sheet stacking RM processes

Week 8 : 3D printing RM processes and laboratory demonstration

Week 9 : Beam Deposition RM processes, and materials in RM

Week 10 : Post-processing and costing in RM

Week 11 : Rapid Product Development (CAD/CAE/CIM)

Week 12 : Rapid Product Development (Software demonstration), and case studies on RM



REINFORCEMENT LEARNING

PROF. BALARAMAN RAVINDRAN

Department of Computer Science
IIT Madras

INTENDED AUDIENCE : Any interested learner

INDUSTRIES APPLICABLE TO : Data analytics/data science/robotics

COURSE OUTLINE :

Reinforcement learning is a paradigm that aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available. It has roots in operations research, behavioral psychology and AI. The goal of the course is to introduce the basic mathematical foundations of reinforcement learning, as well as highlight some of the recent directions of research.

ABOUT INSTRUCTOR :

Prof. Balaraman Ravindran is currently an Professor in Computer Science at IIT Madras and Mindtree Faculty Fellow . He has nearly two decades of research experience in machine learning and specifically reinforcement learning. Currently his research interests are centered on learning from and through interactions and span the areas of data mining, social network analysis, and reinforcement learning.

COURSE PLAN :

Week 1: Introduction

Week 2: Bandit algorithms - UCB, PAC

Week 3: Bandit algorithms - Median Elimination, Policy Gradient

Week 4: Full RL & MDPs

Week 5: Bellman Optimality

Week 6: Dynamic Programming & TD Methods

Week 7: Eligibility Traces

Week 8: Function Approximation

Week 9: Least Squares Methods

Week 10: Fitted Q, DQN & Policy Gradient for Full RL

Week 11: Hierarchical RL

Week 12: POMDPs



SENSORS AND ACTUATORS

PROF HARDIK J PANDYA

Department of Electronic Systems Engineering
IISc Bangalore

PRE-REQUISITES : Basic Electronics

INTENDED AUDIENCE : Engineering Students, Faculty from Engineering Colleges

COURSE OUTLINE :

This course is designed with an aim of educating students in microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real world. The students will also be able to understand how to fabricate some of those sensors. They will have an exposure towards how to fabricate the sensors and its application in real world and understand and also learn modern day microsensors and micro actuators, how to simulate some of those sensors and characterise before fabricating it.

ABOUT INSTRUCTOR :

Prof. Hardik J. Pandya is an Assistant Professor in the Department of Electronic Systems Engineering, Division of Electrical Sciences, IISc Bangalore where he is heading an Advanced Microsystems and Biomedical Devices Facility for Clinical Research as well as Biomedical and Electronic Engineering Systems Laboratory which focuses on the cutting-edge research on novel devices for solving unmet problems in biology and medicine. He is recipient of prestigious Early Career Research Award from Science and Engineering Research Board, Government of India as well as a start-up grant of 228 Lacs from IISc.

COURSE PLAN :

Week1: Basics of Energy Transformation: Transducers, Sensors and Actuators

Week2: Understanding of thin film physics: Application in MOSFET and its variants

Week3: Thin Film Deposition Techniques: Chemical Vapor Deposition (APCVD, LPCVD, UHVCVD, PECVD, ALCVD, HPCVD, MOCVD)

Week 4: Thin Film Deposition Techniques: Physical Vapor Deposition (Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition)

Week 5: Basic understanding of Photolithography for patterning layer. Detailed overview of Etching methods.

Week 6: Understanding various gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured based gas sensors

Week 7: Design and fabrication process of Microsensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications

Week 8: Explain working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications

Week 9: Understanding basics of microfluidics to assist Photomask design using Clewin Software, pattern transfer techniques, PDMS moulding and degassing, device bonding techniques.

Week 10: Simulation, Optimization and characterization of various sensors using COMSOL Multiphysics

Week11: Understanding of Sensor Interfacing with Microprocessor to build electronic system

Week12: Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor based electronics systems



SMART GRID: BASICS TO ADVANCED TECHNOLOGIES

PROF. N.P. PADHY

Department of Electrical Engineering
IIT Roorkee

PROF. PREMALATA JENA

Department of Electrical Engineering
IIT Roorkee

INTENDED AUDIENCE : UG/PG/PhD students, Industries and academic professionals

PRE-REQUISITES : Basic Understanding of Power System and Power Electronics Engineering

INDUSTRY SUPPORT : State Power Transmission and Distribution companies, DISCOMs, TRANSCO, POWER GRID, Private sector: ABB, Schneider, Siemens, etc.

COURSE OUTLINE :

This course covers the fundamental aspects of the smart grid and its application to the existing power system. It introduces state-of-the-art smart grid technologies like electric vehicles, AC/DC microgrids, energy storage, phasor measurement unit, cyber security, etc. In addition, the course talks about the trends, modeling, planning, operation, and control of energy storage technologies. Further, it discusses the architecture, operation, and control strategy of AC, DC, and hybrid AC-DC microgrids. This course also emphasizes on renewable energy sources integration into the present grid and microgrids, and further explores its operation, analysis, management, control, protection, and monitoring issues. The laboratory-scale demonstrations have been provided to validate a few concepts covered in this course.

ABOUT INSTRUCTOR :

Prof. Narayana Prasad Padhy received the Ph.D. degree in power systems engineering from Anna University, Chennai, India, in 1997. He is working as Professor (HAG) with the Department of Electrical Engineering, Indian Institute of Technology (IIT) Roorkee, Roorkee, India. He is currently the Director of the Malaviya National Institute of Technology (MNIT), Jaipur, India and the mentor director of the Indian Institute of Information Technology (IIIT) Kota. Earlier he has served as Dean of Academic Affairs, Institute, NEEPCO, 92 Batch and Ravi Mohan Mangal Institute Chair Professors at IIT Roorkee. He is the National lead of many national and international projects such as DSIDES, ID-EDGE, and HEAPD. He is also part of other international projects, namely Indo-US UI-ASSIST and Indo-UK ZED-I. He has published more than 200 research articles in reputed international journals and conference proceedings. His research interests include power system analysis, demand-side management, energy market, network pricing, AC-DC smart grid, and application of machine learning techniques in power systems. Dr. Padhy is also a Fellow of the Indian National Academy of Engineers (INAE), Fellow Institution of Electronics and Telecommunication Engineers, India, Fellow Institution of Engineering and Technology, UK, and Fellow of Institution of Engineers, India. He was the recipient of the IEEE smart cities jury award 2022, IEEE PES Outstanding Engineers Award 2018, Boyscast Fellowship and the Humboldt Experienced Research Fellowship in the year 2005 and 2009, respectively.

Prof. Premalata Jena (Senior Member IEEE, Young Associate, INAE) received the M. Tech and Ph. D degree in Power System Engg. from the Department of Electrical Engineering, Indian Institute of Technology Kharagpur, Kharagpur, India, in 2006 and 2011 respectively. She is currently working as an Associate Professor in the Department of Electrical Engineering, Indian Institute of Technology, Roorkee, India since 2012. She has executed various sponsored research projects sanctioned by DST, SERB, CPRI, MHRD and THDC INDIA Ltd. She has published several research articles in reputed international journals and conference proceedings. Dr. Jena is a recipient of SERB POER Fellowship from SERB, DST in 2022. Dr. Jena is a recipient of the Women Excellence Award-2017 from DST, New Delhi. Dr. Jena is a recipient of the Young Engineer Award, Indian National Academy of Engineering, and POSOCO Power System Award, Power Grid Corporation of India Ltd., India, in 2013. Her research interest includes power system protection, Electric Vehicle, Grid Integration issues of Electric Vehicle, Optimal sizing and placement of batteries, Cybersecurity issues in Smart Grid, AC, DC, and Hybrid AC-DC microgrid protection issues due to the integration of renewable sources and electric vehicles with the existing power grid.

COURSE PLAN:

Week 1:

- Introduction to Smart Grid-I.
- Introduction to Smart Grid-II.
- Architecture of Smart Grid system
- Standards for Smart Grid system
- Elements and Technologies of Smart Grid System-I

Week 2:

- Elements and Technologies of Smart Grid System-II
- Distributed Generation Resources-I
- Distributed Generation Resources-II
- Distributed Generation Resources-III
- Distributed Generation Resources-IV

Week 3:

- Introduction to energy storage devices
- Different types of energy storage technologies
- Analytical modelling of energy storage devices
- Optimal sizing and siting of storages
- Battery management system (BMS)

Week 4:

- Wide area Monitoring Systems-I
- Wide area Monitoring Systems-II
- Phasor Estimation-I
- Phasor Estimation-II
- Digital Relays for Smart Grid Protection

Week 5:

- Islanding Detection Techniques-I
- Islanding Detection Techniques -II
- Islanding Detection Techniques -III
- Smart Grid Protection-I
- Smart Grid Protection-II

Week 6:

- Smart Grid Protection-III
- Smart Grid Protection-IV
- Modelling of storage devices
- Modelling of DC smart grid components
- Operation and control of AC Microgrid-I

Week 7:

- Operation and control of AC Microgrid -II
- Operation and control of DC Microgrid -I
- Operation and control of DC Microgrid -II
- Operation and control of AC-DC hybrid Microgrid -I
- Operation and control of AC-DC hybrid Microgrid -II

Week 8:

- Phasor measurement unit placement
- Cyber security and resiliency
- Virtual inertia and ancillary support
- Demand side management of smart grid
- Demand Response Analysis of smart grid

Week 9:

- Demonstration of solar power generation
- Demonstration of wind power generation
- Demonstration of Battery Management System
- Demonstration of EV charging system
- Hierarchical control techniques in hybrid ac-dc microgrid

Week 10:

- Simulation and case study of AC Microgrid
- Simulation and case study of DC Microgrid
- Simulation and case study of AC-DC Hybrid microgrid
- Demonstration of parallel inverter operation in AC microgrid
- Harmonic effects and its mitigation techniques

Week 11:

- Energy management
- Design of Smart Grid and Practical Smart Grid Case Study-I
- Design of Smart Grid and Practical Smart Grid Case Study-II
- System Analysis of AC/DC Smart Grid
- Demonstration of grid-connected DC microgrid

Week 12:

- Demonstration of energy management in microgrid
- Demonstration of PHIL experimentation for symmetric and asymmetric fault analysis of grid-connected DFIG wind turbine.
- Demonstration of ancillary support from virtual synchronous generator
- Demonstration on peak energy management using energy storage system.
- Conclusions



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Software Testing

By Prof. Meenakshi D'souza | IIIT Bangalore

Learners enrolled: 15572

Software Testing _ Course Introduction



ABOUT THE COURSE :

This course will cover various techniques for test case design, as used for testing of software artifacts including requirements, design and code. We will discuss algorithms and techniques for test case design based on graphs, logic, syntax of programming

Summary

Course Status :	Completed
Course Type :	Elective
Duration :	12 weeks
Category :	◦ Computer Science and Engineering
Credit Points :	3
Level :	Undergraduate/Postgraduate
Start Date :	25 Jul 2022
End Date :	14 Oct 2022
Enrollment	08 Aug 2022
Ends :	
Exam Date :	30 Oct 2022 IST





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INTENDED AUDIENCE: Any Interested Learners
PRE-REQUISITES: Programming, Algorithms, Discrete Mathematics (basics) (<https://swayam.gov.in/c-details/NPTEL>)
INDUSTRY SUPPORT: The material of this course has been used to offer training for Samsung, ABB and Mindtree. The course will be useful for any firm that does tests their software.

inputs. Special techniques for testing object-oriented features and web so be discussed. The course will end with a project. About Swayam (<https://swayam.gov.in/about>)
These broadly cover test cases for both white-box and black-box.

Note: This exam date is subjected to change based on availability. You can check final exam date on your hall ticket.

This is an AICTE approved FDP course

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(https://www.addtoany.com/share?url=https%3A%2F%2Fonlinecourses.nptel.ac.in%2Fnoc22_cs61%2Fpr%20Course)

Course layout

- Week 1:** Techniques and algorithms for test case design: Graphs based testing- structural coverage criteria.
- Week 2:** Graphs based testing: Data flow coverage criteria
- Week 3:** Graphs based testing: Data flow coverage criteria
- Week 4:** Graphs coverage for source code, design elements and requirements
- Week 5:** Techniques and algorithms for test case design: Logic based testing- Predicates, logic based coverage criteria
- Week 6:** Specification based logic coverage, logic coverage on finite state machines
- Week 7:** Input space partitioning: Input domain modeling, combination strategies criteria
- Week 8:** Syntax based testing: Coverage criteria based on syntax, mutation testing
- Week 9:** Test case design (as learnt above) applied to object-oriented applications
- Week 10:** Test case design (as learnt above) applied to web applications
- Week 11:** Symbolic testing
- Week 12:** Concolic testing, Conclusion





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Instructor bio

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**Prof. Meenakshi
D'souza**

IIIT Bangalore

Prof. Meenakshi D'souza is currently an Associate Professor at IIIT-Bangalore. Meenakshi did her Master TMs in Mathematics from University of Madras, Chennai and her Ph. D. in Theoretical Computer Science from The Institute of Mathematical Sciences, Chennai. She joined the research department of Honeywell Technology Solutions, Bangalore soon after completing her Ph. D. and worked there in the areas of Formal Verification of Software Design, Model Based Development and Physical Access Control before joining IIIT-Bangalore. Her research interests are in Formal Methods, Model Based Development, Software Testing and Automata Theory.

Course certificate

The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: **30 October 2022** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12





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Final score = Average assignment score + Exam score



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SCORE >= 10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you
will not get the certificate even if the Final score >= 40/100.**

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Initiative by : Ministry of Education (Govt of India)





STRUCTURAL ANALYSIS - I

PROF. AMIT SHAW

Department of Civil Engineering
IIT Kharagpur

INTENDED AUDIENCE : Civil Engineering Architecture

PRE-REQUISITES : Solid Mechanics

INDUSTRIES APPLICABLE TO : All civil engineering companies

COURSE OUTLINE :

This is an elementary course on Structural Analysis. Various methods and their underlying mechanics in determining response of structures when subjected to external agitation will be discussed in this course. This course is comprehensive at the basic level. Journey through this course will help students to build the foundation for more advanced courses related to structural engineering.

ABOUT INSTRUCTOR :

Prof. Amit Shaw is presently an Associate Professor in the Department of Civil Engineering, IIT Kharagpur. He obtained his Bachelors degree in Civil Engineering from IEST Shibpur (formerly Bengal Engineering College Shibpur) in 2000, MTech in Structures from IIT Roorkee in 2003 and PhD in Computational Mechanics from IISc Bangalore in 2007. Prior to joining IIT Kharagpur, Professor Shaw spent two years as Research Fellow in University of Aberdeen, UK. He also worked for some time in industries like Gammon India Limited and L&T ECC.

COURSE PLAN :

Week 1: Equilibrium, Stability and Determinacy of structures; Review of shear force and bending moment diagram in beams and frames

Week 2: Analysis of statically determinate structures 1; Plane truss: method of joints and method of sections

Week 3: Analysis of statically determinate structures 2; Deflection of truss: Method of virtual work

Week 4: Analysis of statically determinate structures 3; Deflection of beams and frames 1: Moment area method, conjugate beam method and virtual work method

Week 5: Analysis of statically determinate structures 4; Deflection of beams and frames 2: Moment area method, conjugate beam method and virtual work method

Week 6: Analysis of statically determinate structures 5; Influence line diagram and moving loads

Week 7: Analysis of statically indeterminate structures 1; Introduction to force and stiffness method

Week 8: Analysis of statically indeterminate structures 2; Plane truss using method of consistent deformations

Week 9: Analysis of statically indeterminate structures 3; Beams and Frames: Method of consistent deformations

Week 10: Analysis of statically indeterminate structures 4; Beams and Frames: Moment distribution method

Week 11: Analysis of statically indeterminate structures 5; Beams and Frames: Slope deflection method

Week 12: Introduction to direct stiffness method



SUSTAINABLE ENERGY TECHNOLOGY

PROF. SAYAK BANERJEE

Department of Mechanical and Aerospace Engineering
IIT Hyderabad

INTENDED AUDIENCE : UG and PG students as well as working professionals in Mechanical, Chemical, Civil, Energy and Environmental Engineering wishing to gain a broad expertise on sustainability issues in Energy Technology.

COURSE OUTLINE :

The world is passing through revolutionary shift in the field of energy generation and utilization as sustainability problems related to pollution and climate change force a shift from traditional fossil fuel based energy to renewable and carbon neutral sources of energy. This course attempts to provide a synoptic overview of the rapidly developing ecosystem of sustainable energy technologies that are being developed and deployed to exploit the various carbon neutral energy resources, to improve the efficiency and sustainability of current energy systems and to develop a more flexible energy grid and energy storage system for the future. India is expected to remain as one of the largest producers and consumers of energy in this coming decades and challenges and opportunities for the Indian energy ecosystem will also be highlighted. While the course will not delve deep into any one technology, the course will provide a broad description of each of the technologies and their associated basic theoretical and analytical underpinnings.

ABOUT INSTRUCTOR :

Prof. Sayak Banerjee is an Assistant Professor at the Mechanical and Aerospace Department at the Indian Institute of Technology, Hyderabad and is also an Adjunct Professor at the Climate Change Department at IIT Hyderabad. He had completed his M Tech in Mechanical Engineering from IIT Kanpur and his PhD and Post-Doctoral research on bio-aviation fuel combustion kinetics from the Stanford University, USA. His research specialization is in the field chemical kinetics experimentation and modelling associated with the gasification, pyrolysis and combustion of novel carbon neutral fuels (biomass, hydrogen, biodiesel, biojet fuels etc.). He has taught the Sustainable Energy Technology Course at IIT Hyderabad as an M. Tech/ B.Tech elective for Mechanical and Climate Change Departments for over 3 years

COURSE PLAN :

Week 1 : Introduction and Fundamental Concepts, Energy Scenario in Modern World

Week 2 : Fossil Fuels, Climate Change Impacts and Overview of Renewable energy Technology

Week 3 : Hydropower

Week 4 : Wind Energy

Week 5 : Solar Energy

Week 6 : Solar Photovoltaic Systems

Week 7 : Bioenergy and Biofuels

Week 8 : Geothermal Energy, Introduction of Energy storage systems

Week 9 : Mechanical energy storage technologies, Energy storage system through Capacitor

Week 10 : Electrochemical Energy Storage Systems, Thermal Energy Storage Systems

Week 11 : Trends in Energy Storage Types and their Characteristics

Week 12 : Fuel Cells and Hydrogen Energy, Carbon Capture and Storage (CCS)

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Sustainable Power Generation Systems

By Dr. Pankaj Kalita | IIT Guwahati

Learners enrolled: 4997 | Exam registration: 1210

Sustainable Power Generation Systems [Intro Video]



ABOUT THE COURSE:

The course content is designed to provide comprehensive knowledge of various renewable energy systems. Specifically, in this course, the design and analysis of renewable energy power plants will be discussed. The concepts will be illustrated with practical examples, schematics and block diagrams wherever required. A sufficient number of numerical problems with solutions will be discussed in the course. This course is specifically designed for undergraduate and postgraduate students of Energy Engineering and Technology. Further, the course will be very much useful for students and researchers from varied academic backgrounds for the synthesis of novel energy conversion devices and processes.

INTENDED AUDIENCE: UG, PG, Doctorate students and renewable energy professionals

PREREQUISITES: Basic knowledge of thermal science

INDUSTRY SUPPORT: This course will be very much effective for the engineers working in the various renewable energy based companies/industries. Some of the following companies that will recognize this course are

- Renergy Solutions Pvt limited
- Susconnect Pvt Limited
- Suzlon Energy Limited

- Vikram Solar Pvt. Lin

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Summary

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Course Status :	Completed
Course Type :	Elective
Duration :	12 weeks
Category :	◦ Multidisciplinary ◦ Electrical, Electronics and Communications Engineering ◦ Mechanical Engineering ◦ Energy and Environment ◦ Power Systems and Power Electronics
Credit Points :	3
Level :	Undergraduate/Postgraduate
Start Date :	24 Jul 2023
End Date :	13 Oct 2023
Enrollment Ends :	07 Aug 2023
Exam Registration Ends :	18 Aug 2023
Exam Date :	29 Oct 2023 IST

Note: This exam date is subject to change based on seat availability. You can check final exam date on your hall ticket.

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Course layout

Week 1: Module-1: Introduction to power generation

Global and Indian scenario, an overview of current technologies available for power generation, Concept of the renewable energy- based power plant

Week 2: Module-2: Solar Thermal Power Generation

Fundamentals of Solar thermal energy conversion, solar thermal based power plant design and analysis (flat plate and concentrator), ORC, RC, and Stirling engine.

Week 3: Module-3: Solar Photovoltaic Power Generation

Fundamentals of Solar photovoltaic energy conversion, Solar PV power plant design, Performance analysis of standalone and grid connected PV systems.

Week 4: Module-4: Wind Power Generation

Introduction to wind turbine, classification and analysis of different components, Theory, design and analysis of wind turbines (horizontal axis and vertical axis) and wind farms.

Week 5: Module-5: Hydro

Introduction to hydro power and turbines, Brief theory, (https://swayam.gov.in/) of micro, mini and small hydro power plants, hydraulic turbines, Selection and design criteria of pumps and turbines, Brief theory, (https://swayam.gov.in/nc_details/NPTEL) is of hydro power plants

Week 6: Module-6: Biomass Power Generation

Fundamentals of bioenergy production technologies through different routes, design and analysis of biochemical and thermochemical reactors for clean power generation and value-added products, IGCC. About Swayam (https://swayam.gov.in/about) | All Courses |

Week 7: Module-7: Hydrogen energy and fuel cells

Importance, various routes of hydrogen generation, basic principle and design of different types of fuel cells and their applications, future prospects, IGFC

Week 8: Module-8: Geothermal Energy

Fundamentals, classification, theory, design and analysis of geothermal power plant

Week 9: Module-9: Ocean Thermal Energy

Fundamentals, classification, theory, design and analysis of ocean thermal power plant

Week 10: Module-10: Wave and Tidal Energy

Fundamentals, classification, theory, design, and analysis of wave and tidal power plant

Week 11: Module-11: Energy Storage

Different modes of energy storage; design and analysis of different technologies for thermal, mechanical, and electro-chemical energy storage systems

Week 12: Module-12: Energy Economics

Cost analysis, interest, Accounting rate of return, Payback, Discounted cash flow, Net present value, Internal rate of return, Inflation and life cycle analysis of energy systems.

Books and references

1. J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021.
2. G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University press, 3rd Edition, 2012.
3. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition, 2013.
5. R. Gasch, J. Tvele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2nd Edition, 2012.
6. P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
7. S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, Springer, 2nd Edition, 2019.
8. S.p Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Private Limited, 3rd Edition, 2010.

Instructor bio



Dr. Pankaj Kalita

IIT Guwahati

Dr. Pankaj Kalita is Associate Professor in the School of Energy Science and Engineering, Indian Institute of Technology Guwahati. He has completed his master degree in Mechanical Engineering (specialization: Fluids and Thermal Engineering) and PhD in Energy from IIT Guwahati. He worked as Assistant Professor in the Department of Energy at Tezpur University, Assam before joining at IIT Guwahati. He has more than 10 years of teaching and 16 years of research experience in various field of renewable energy. He has published more than 100 articles in various peer reviewed journals and conferences. He has also contributed one book and 16 book chapters in different books. He is a recipient of India Distinguished Visiting Fellow awarded by the University of Nottingham, United Kingdom in the year 2010. He has guided many PhD and master students. He has successfully implemented eight research projects and several consultancy projects funded by different government and private agencies in the fields of energy generation, energy management, energy modelling, solar power plant design, engine testing etc. At present three research projects are in progress in the areas of clean energy technologies for power generation, and hybrid (biomass and solar) drying technologies. His current areas of research

include solar energy conversion, wind energy conversion, nuclear and biochemical conversion, energy management, energy storage (li-ion and thermal energy) and integration of renewable energy sources.



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Course certificate

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The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: **29 October 2023** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.

Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

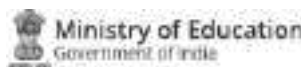
YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Guwahati. It will be e-verifiable at nptel.ac.in/noc (<http://nptel.ac.in/noc>).

Only the e-certificate will be made available. Hard copies will not be dispatched.

Once again, thanks for your interest in our online courses and certification. Happy learning.

- NPTEL team



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Initiative by : Ministry of Education (Govt of India)



THE JOY OF COMPUTING USING PYTHON

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

INTENDED AUDIENCE : Any interested audience

PREREQUISITES : 10th standard/high school

INDUSTRY SUPPORT : Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!



THERMAL PROCESSING OF FOODS

PROF. R. ANANDALAKSHMI

Department of Chemical Engineering
IIT Guwahati

INTENDED AUDIENCE : The target audience for this course is

- BTech/MSc/MTech/PhD students or faculties from reputed academic and technical institutions interested in acquiring knowledge of thermal food processing technologies
- Those who are pursuing a career as a chemical engineer or food engineer or biotechnologist designing thermal processing technologies for food processing or working with thermal processing of foods
- Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories working in the area of thermal food processing

INDUSTRY SUPPORT : Food Corporation of India, Department of food & Public Distribution, India Central Food Technological Research Institute, Institute of Food Security and Central Warehousing Corporation. Some of the private sectors are Amul, Perfetti Van Melle India Pvt. Ltd., Parley Products Ltd., PepsiCo India Ltd. etc

COURSE OUTLINE :

The Food and Agriculture Organization (FAO) of the United Nations (UN) issued a report on the importance and complexities associated with feeding the projected 9.1 billion world population in 2050. Sustainable production of safe and nutritious foods, development of foods that have a long shelf life and foods that are either ready-to-eat or easy to are of greater importance towards meeting this goal. Understanding "Food Engineering" and "Thermal Processing of Foods" serves as basic requirement means of meeting this goal.

ABOUT INSTRUCTOR :

Prof. R. Anandalakshmi is an Associate Professor in the Department of Chemical Engineering, Indian Institute of Technology, Guwahati. Her research interests are in the area of Computational Heat Transfer and Fluid Flow, Process Modeling and Simulation, Solar Thermal Energy Conversion, Energy Efficient Design of Thermal Systems, Microwave Assisted Food and Material Processing, Food Packaging and Preservation, Refrigeration and Air-conditioning Systems.

COURSE PLAN :

Week 1: Food microbiology: microbial growth and concerns in various foods, Blanching, Pasteurization, Ultra-pasteurization, Hot fill and UHT

Week 2: Thermal processing equipment, Milk pasteurization, Canning operations

Week 3: Temperature distribution and heat penetration, Kinetics of reactions, F value and process requirements

Week 4: Quality considerations and process optimization, Shelf life studies, Validation of heat processes

Week 5: Fundamentals of aseptic processing, Aseptic equipment design, Aseptic process design

Week 6: Microwave and radio frequency heating, Ohmic heating, Overview of non-thermal processing technologies

Week 7: Advanced separation processes high pressure, dialysis ultrafiltration and reverse osmosis nanofiltration, electro dialysis and membrane separation

Week 8: Various types of heat exchangers for food process engineering Various types of driers for food process engineering

Week 9: Importance and applications of extrusion technology in food processing Changes of properties and functional components of extruded foods

Week 10: Food biosensors Types of functional foods: Probiotics and nutraceuticals

Week 11: Packaging considerations: Barrier and mechanical properties of different food packaging materials biocomposite/bionanocomposite materials for food packaging applications

Week 12: Sanitary components and requirements, Regulatory considerations

NOC: Understanding Design Thinking & People Centred Design - Video course

COURSE OUTLINE

This is an introductory orientation to help enrollees understand the notions of Design Thinking and People Centered Design and how a PCD approach is different from traditional engineering or marketing focused approaches.

Today DT and PCD are being rapidly adopted and have achieved center stage by various industries. Students from any stream as well as professionals from various industries and levels of experience can learn these simple methods, concepts and tools. In order to master the topic however, they must actually execute a project to apply the teachings, which is not a part of this course.

Since this topic has very wide applicability, students will benefit from applying these in their projects and work thereafter, regardless of their area of work.

COURSE DETAIL

WeekNo.	Topics
1.	INTRODUCTION and PROBLEM DISCOVERY Intro to Design Thinking, People Centered Design & Evoking the 'right problem'
2.	RESEARCH AND ANALYSIS People and Context Research and Design Insights and Strategy
3.	CONCEPTING and BUILDING Conceptualize Designs, Create a Concept, Storyboarding and Rapid Prototyping
4.	TESTING, REFINING and PITCHING Usability Testing, Refine and Enhance Design and Define pitch



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**Humanities
and Social
Sciences**

Pre-requisites:

Bachelors Degree in Engineering, Technology, Business, Architecture, Humanities

Coordinators:

Prof. Jhumkee Iyengar
Design Program IIT Kanpur



WHEELED MOBILE ROBOTS

PROF. ASOKAN THONDIYATH

Department of Engineering Design
IIT Madras

PROF. SANTHAKUMAR MOHAN

Department of Mechanical Engineering
IIT Palakkad

INTENDED AUDIENCE : Undergraduate/graduate students interested in mobile robotics

COURSE OUTLINE : Upon completion of the course, the students should be able to: • Learn algorithmic approaches, mathematical models and computational and motion control methods applicable to mobile robotic systems • Learn basic sensor systems related to state measurements, navigation and localization. • Learn different motion planning and navigation schemes related to mobile robots • Recognize and analyze the basic mechanical and electrical systems concerning robots' locomotion and manipulation • Analyze and design the basic mobile robotic systems

ABOUT INSTRUCTOR :

Prof. T. Asokan is a Professor in the Department of Engineering Design, and currently the Head of the Department, at IIT Madras. He completed his B.Tech. and M.Tech. in mechanical engineering and received his Ph.D in Mechanical Engineering from the Indian Institute of Technology Madras. Prior to joining IIT Madras, he was with the Robotics Research Center, Nanyang Technological University, Singapore working in the area of robotic system development. He was awarded the Stanford-India biodesign fellowship by the Stanford University, USA in 2009 and has completed a post doctoral fellowship in medical device development at the Stanford University. He is currently the national secretary of The Robotics Society. He has more than 25 years of professional experience in research and teaching in the broad areas of Robotics, Product design, and Engineering System design. Dr Asokan has published more than 100 papers in International Journals and conferences and has filed 18 patents in India, USA, and Singapore. More details can be found at <https://ed.iitm.ac.in/~asokan/>

Prof. Santhakumar Mohan is an Associate professor in the department of Mechanical Engineering, Indian Institute of Technology Palakkad. He has more than 10 years of professional experience in teaching and research. He has been teaching the course on Wheeled mobile robots (shortly mobile robotics) for the last 7 years for both undergraduate and postgraduate students. He is active in the design and development of mobile robots for field applications and has 4 patents filed in India. For more details please visit the webpage(<https://iitpkd.ac.in/people/santhakumar>).

COURSE PLAN :

Week 1: Introduction to mobile robots and mobile manipulators. Principle of locomotion and types of locomotion. Types of mobile robots: ground robots (wheeled and legged robots), aerial robots, underwater robots and water surface robots.

Week 2: Kinematics of wheeled mobile robot, degree of freedom and maneuverability, generalized wheel model, different wheel configurations, holonomic and non-holonomic robots.

Week 3: Dynamics of mobile robot: Lagrange-Euler and Newton-Euler methods. Computer based dynamic (numerical) simulation of different wheeled mobile robots.

Week 4: Sensors for mobile robot navigation: magnetic and optical position sensor, gyroscope, accelerometer, magnetic compass, inclinometer, tactile and proximity sensors, ultrasound rangefinder, laser scanner, infrared rangefinder, visual and motion sensing systems.

Week 5: Robot navigation: Localization, Error propagation model, Probabilistic map based localization, Autonomous map building, Simultaneous localization and mapping (SLAM).

Week 6: Motion and path planning: collision free path planning and sensor-based obstacle avoidance.

Week 7: Motion control of mobile robots: Motion controlling methods, kinematic control, dynamic control and cascaded control.

Week 8: Introduction to modern mobile robots: Swarm robots, cooperative and collaborative robots, mobile manipulators, autonomous mobile robots.



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Dr. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed eight video and one web course under the National Programme on Technology Enhanced Learning (NPTEL, MOOCs). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

Course certificate

- The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
- The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
- **Date and Time of Exams: 29 September 2019**, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
- Registration url: Announcements will be made when the registration form is open for registrations.
- The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
- Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

- Average assignment score = 25% of average of best 3 assignments out of the total 4 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100.
- Final score = Average assignment score + Exam score.



ADVANCED MACHINING PROCESSES

PROF. MANAS DAS

Department of Mechanical Engineering
IITGuwahati

INTENDED AUDIENCE : Intended for UG and PG students who plan to take up this subject as their future research area. Also, for practitioner in industries who want to implement new development technologies in advanced machining to their factory.

INDUSTRIES APPLICABLE TO : Bharat Heavy Electricals Limited (BHEL), Hindustan Aeronautics Limited (HAL), Defense Research and Development Organization (DRDO), Die manufacturing industries, Automobile Industries, Machine Tool Industries, Precision medical equipment manufacturing industries, High precision optics and semiconductor industries

COURSE OUTLINE :

There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and workpieces with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called unconventional in the sense that conventional tools are not employed for metal cutting. Instead, energy in its direct form is used to remove the material from the workpiece. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of unconventional / nontraditional / modern machining processes.

ABOUT INSTRUCTOR :

Prof. Manas Das is an Assistant Professor in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati, India since 2012. He received his Masters and Ph.D. degree from Mechanical engineering Department, IIT Kanpur. His research areas include Advanced Finishing and Nano-finishing Processes, Magnetorheological Finishing (MRF) Process, Advanced/Non-traditional Machining Processes, Micromachining processes. Dr. Das has published more than 20 papers in reputed journal and conferences. He has also written 2 book chapters in the area of surface finishing. Presently, he is supervising 5 Ph.D. students in the broad area of manufacturing.

COURSE PLAN :

Week 1 : Introduction to advanced machining processes and their classification
Ultrasonic machining and its modelling and analysis

Week 2 : Abrasive jet machining (AJM)

Water jet cutting (WJC) and Abrasive water jet machining (AWJM)
Magnetic abrasive finishing (MAF) and its modelling

Week 3 : Abrasive flow finishing (AFF) and its modelling
Magnetorheological finishing (MRF)

Week 4 : Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis

Week 5 : Electric discharge machining (EDM): Principle, applications, process parameters, and modelling

Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM)

Week 6 : Laser beam machining (LBM)

Plasma arc machining (PAM)

Electron Beam Machining (EBM)

Week 7 : Electro chemical machining (ECM): Principle, applications, and process parameters and modelling

Week 8 : Electrochemical Grinding (ECG), Electrostream Drilling (ESD), Shaped Tube Electrolytic Machining (STEM), Chemical machining (ChM)



ADVANCED ROBOTICS

PROF. ASHISH DUTTA

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : Basic Mathematics : matrices, differential equations

INTENDED AUDIENCE : Students (UG 3rd/4th year in Mechanical/Electrical/Computer Science), Teachers of engineering colleges, Industry professorial

INDUSTRY SUPPORT : All Manufacturing companies (TATA motors, Mahindra, Maruti, Hyundai, GE, GM, etc), IT companies (TCS, Infosys, etc), process industries using robotics

COURSE OUTLINE :

The course is intended as a second level course for students, teachers and industry personal interested in learning the advanced concepts in robotics, as required in the design and control of robotic systems. This course is not intended as a basic course for learning robotics. The course starts with an introduction to robotics, linkages and workspaces, transformations, kinematics, trajectory planning and dynamics. Next, singular value decomposition is introduced to explain the concept of manipulation ability that is followed by the basics of linear control methods. The course also introduces advanced topics like modeling and analysis of multi-finger grasping, legged robots, their design and optimization with real world applications.

ABOUT INSTRUCTOR :

Prof. Ashish Dutta obtained his PhD in Systems Engineering from Akita University, Japan, M.Tech from Jadavpur University and B.Tech from NIT Calicut. From 1994 to 2000 he was with the Bhabha Atomic Research Center, Mumbai where he worked on telemanipulator design and control for nuclear applications. Since 2002 he is with the department of mechanical engineering at IIT Kanpur, India. He was also a visiting professor in Nagoya University, Japan in 2006 and is currently a visiting professor at Kyushu Institute of Technology, Japan (2015 -). His research interests are in the areas of humanoid robotics, motion planning in 3D, intelligent control systems and rehabilitation engineering. Prof. Dutta has also served as advisory board member of ISRO Chandrayan II Lunar mission (2009), member of Task force on AI of the Ministry of Commerce and Industry (2017), Secretary of The Robotics Society of India (2011-2017), member Bureau of Indian Standards (Robotics Section), Chairman India-South Korea robotics working group (2013-), Chairman IEEE Robotics and Automation section (UP, UK section), etc.

COURSE PLAN :

Week 1: Introduction, transformations

Week 2: DH Parameters

Week 3: Forward and Inverse Kinematics, redundancy resolution

Week 4: Velocity kinematics and Jacobian

Week 5: Singular value decomposition, singularity and manipulation ability

Week 6: Trajectory planning, dynamics

Week 7: Sensors and actuators as used in robotics

Week 8: Basics of linear control – PD, PID controller, model based control, stability

Week 9: Multi finger grasping – form, force closures, grasp matrix

Week 10: Locomotion – active and passive walkers, concepts of balance

Week 11: Biped Gait and Balance using ZMP, kinematics and dynamic modeling of walk

Week 12: Design and Optimization of legged mechanisms



ASPEN PLUS® SIMULATION SOFTWARE - A BASIC COURSE FOR BEGINNERS

PROF. PRABIRKUMAR SAHA

Department of Chemical Engineering
IIT Guwahati

PRE-REQUISITES : People having Chemical Engineering background who have passed the following courses: Mass Transfer, Heat Transfer, Chemical Reaction Engineering, Fluid Mechanics, Chemical Engineering Thermodynamics, and Mechanical Operations.

INTENDED AUDIENCE : Final year UG chemical engineering students and PG students having chemical engineering background. People from chemical process industries may also get benefitted with this course.

INDUSTRY SUPPORT: All chemical process industries such as Reliance petrochem, Shell, IOCL, etc.

COURSE OUTLINE :

Aspen Plus is a process modeling tool used for process monitoring, optimization and conceptual design, especially by chemical process industries. This is a simple course on Aspen Plus Simulation engine that will teach one how to model the most common unit operations of a chemical plant. Basic unit operations such as Pump, Reactor, Valve, Heater, Distillation Column etc. will be demonstrated which would be helpful for students, teachers, engineers and researchers in the area of R&D and Plant Design/Operation. The course is didactic, with a lot of applied theory and case studies. At the end of the course one will be able to setup a simulation, run it, get design parameters, optimize and get results. This is highly recommended for those who are willing to take a career in simulation/modeling via software.

ABOUT INSTRUCTOR :

Prof. Prabirkumar Saha received his Bachelors of Engineering degree in Chemical Engineering from Jadavpur University, India in 1992 and his Masters of Technology and Ph.D. degrees in Chemical Engineering from the Indian Institute of Technology Madras, in 1994 and 1998, respectively. He has got 22 years of post-PhD experience both in industry and academia. Prior to joining his present job, he had undertaken professional responsibilities at the National University of Singapore, General Electric (USA) and Cranfield University (England). Currently, he is a Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati. He has published about 70 refereed journal and conference papers. His research interest covers process control and liquid membrane based separation process. Prof. Saha is a recipient of Fulbright-Nehru Award for International Education Administrators. He is a Senior Life Member of American Institute of Chemical Engineers.

COURSE PLAN :

Week 1: Basic Process Modelling

Week 2: Basic Process Modelling

Week 3: Basic Process Modelling

Week 4: Process and property analysis

Week 5: Process and property analysis

Week 6: Process and property analysis

Week 7: Case studies

Week 8: Case studies

Week 9: Case studies

Week 10: Case studies

Week 11: Case studies

Week 12: Case studies



BASIC PRINCIPLES AND CALCULATIONS IN CHEMICAL ENGINEERING

PROF. SUBRATA KUMAR MAJUMDAR

Department of Chemical Engineering

IIT Guwahati

PRE-REQUISITES : 10+2 Examination in science

INTENDED AUDIENCE : Chemical, BioChemical, chemical science and Technology / Chemical Engineering Petroleum science and technology

INDUSTRIES APPLICABLE TO : Industrial Research and development section of chemical and Biochemical Engineering

COURSE OUTLINE :

The objective of the course is to introduce chemical engineering students to the basic principles and calculation techniques used in the chemical industries and to acquaint them with the fundamentals of the material and energy balances as applied to chemical engineering processes. The course is mainly intended for graduate chemical engineering student. It will expose them to solve the problems in material and energy balances that arise in relation to the problems involving in different chemical process units. It also will introduce them to numerical methods used to solve the problems. The course will introduce in simple language and ample of examples so that it will encourage learners to get used to the course.

ABOUT INSTRUCTOR :

Prof. Subrata Kumar Majumder is a Professor in the Chemical Engineering Department, IIT Guwahati, India. His research interests include multiphase flow and reactor development, hydrodynamics in multiphase flow, mineral processing, process intensifications and micro-nano bubble science and technology and its applications. He is a Fellow of the International Society for Research and Development, 8A Kapteinsvigein, London, UK. He is also a recipient of various honours and awards like: Editor, Journal of Chemical Engineering Research Studies, Guest editor, American Journal of Fluid Dynamics, published by Scientific & Academic Publishing Co., CA, 91731, USA, Editorial board member of Scientific Journal of Materials Science, IIME Award on beneficitation from Indian Institute of Mineral Engineers (IIME), Editorial board Member of the Journal of Science and Technology, Scientific and Academic Publishing, USA, Advisory board member of Excelling Tech Publishers (ETP), London, UK. He is a life member of Indian Institute of Chemical Engineers, Indian Institute of Mineral Engineers, member of Institute of Engineers (India), Member of Asia-Pacific Chemical, Biological & Environmental Engineering Society (PCBEE), senior member of International Association of Engineers (IAE), Japan. He authored four books, five book chapters, and has more than 80 publications in several reputed international journals. Presently he is working in the field of Microbubble science and technology and its applications in mineral beneficiation, food processing and arsenic, ammonia and dye removal and process intensifications by developing ejector-induced gas aided extraction process.

COURSE PLAN :

Week 1: Introduction

Contents:

Definition, history and role of chemical engineers: Definition of chemical engineering, role of chemical engineers in society

Basic features of chemical process: Classifications and modes of chemical processes; basic features of chemical process and unit operation

Unit systems and dimensions: Dimensional homogeneity and its analysis, Analysis of problem with solution

Week 2: Process Variables and Rate

Contents:

Variables and properties of material in systems: Physical and transport properties of materials and mixtures, Analysis of problem with solution

Pressure and temperature of flow process: Pressure and temperature and their measurements in flow process, problem solving

Rate of chemical processes: Flow rate and its measurements, Flow rate and its measurements, Rate of momentum transfer, Rate of heat transfer, Rate of mass transfer, Analysis of problem with solution Solving problems³

Week 3: Fundamentals of Material Balance

Contents:

Principles of material balance and its calculation: basis of engineering calculations, the general material balance equation, Balances on single and multiple unit processes without reaction, Solving problems

Material balances on non-reactive processes: Material balances on non-reactive processes with recycle and bypass, Solving problems

Material balances on reactive processes: Material balances on reactive processes, Solving problems

Material balances on combustion processes: Material balances based on combustion reactions, Solving problems

Week 4: Basic Principles of Compressible System

Contents:

State equation of ideal gas and calculation: Basic equations of state for ideal gas and their calculations;

State equation of non-ideal gas and calculation: Basic equations of state for non-ideal gas and their calculations

Week 5: Basic Principles of Multiphase System

Contents:

Phase equilibrium and Vapour Pressure: Phase equilibrium, Gibb's phase law, Clausius-Clapeyron Equation, Antoine's Equation, Cox Chart

Equilibrium laws: Raoul's Law, Henry's law, volatility, their calculations with examples

Saturation and Humidity: Principles of saturation, humidity, Psychrometric chart and its use, problem solving

Process of phase change: Condensation, vaporization, Examples

Week 6: Energy and Its Forms

Contents:

Principles of Energy: concepts and units, Different forms of energy and their calculations, The general energy balance equation

Laws and Properties of thermodynamics: Laws of thermodynamics, definitions of thermodynamic properties like Heat capacity, enthalpy, entropy; Calculation of enthalpy changes (without change of phase), enthalpy changes for phase transitions

Heat of formation, reaction and solution: Definition and calculations

Week 7: Energy Balances on Non-reactive Processes

Contents:

The mechanical energy balance: basic understanding with example

Enthalpy balances without reaction: basic understanding with example

Energy balances on non-reactive processes of multiple inlet and outlet streams: basic understanding with example

Enthalpy balances for heat of solution: Analysis with example

Week 8: Energy Balances on Reactive Systems

Contents:

Energy balance with standard heat of reaction: basic understanding with example

Energy balance with heat of reaction: basic understanding with example

Energy balances on heat of combustion: basic understanding with example

Week 9: Balances on Unsteady State Processes

Contents:

Material balances of unsteady state process: basic understanding with example

Unsteady state energy balance: basic understanding with example; Example of simultaneous material and energy balance

Week 10: Computational Techniques

Contents:

The methods of least squares: Linear equation fitting with experimental data with example

Non-linear algebraic equation system: basic understanding with example

Numerical Integration: basic understanding with example

Week 11: Computer-aided Balance Calculations

Contents:

Degree of freedom analysis: basic understanding with example

Process flow sheeting and codes: basic understanding

Week 12: Case Studies on Chemical Process

Contents:

Case study-I on chemical process: Analysis with example

Case study-II on chemical process: Analysis with example 3



BUSINESS ANALYTICS AND DATA MINING MODELING USING R

PROF. GAURAV DIXIT

Department of Management Studies
IIT Roorkee

PRE-REQUISITES : Basic Statistics Knowledge

INDUSTRIES APPLICABLE TO : Big Data companies, Analytics & Consultancy companies, Companies with Analytics Division

COURSE OUTLINE :

Objective of this course is to impart knowledge on use of data mining techniques for deriving business intelligence to achieve organizational goals. Use of R (statistical computing software) to build, assess, and compare models based on real datasets and cases with an easy-to-follow learning curve.

ABOUT INSTRUCTOR :

Prof. Gaurav Dixit is an Assistant Professor in the Department of Management Studies at the Indian Institute of Technology Roorkee. He earned his doctoral degree from the Indian Institute of Management Indore and an engineering degree from Indian Institute of Technology (BHU) Varanasi. Previously, he worked in Hewlett-Packard (HP) as software engineer, and Sharda Group of Institutions as project manager on deputation. Gaurav's research focuses on information technology (IT) strategy, electronic commerce, electronic waste, data mining, and big data analytics and provides insights on business and social value of IT. His research has appeared in quality journals & conferences, including Resources, Conservation and Recycling, Journal of Global Information Technology Management, Sustainable Production and Consumption, Journal of Information Technology Management, DIGITS conference, India Finance Conference, Indian Academy of Management conference, and Academy of Management conference.

COURSE PLAN :

Week 1: General Overview of Data Mining and its Components Introduction and Data Mining Process Introduction to R Basic Statistical Techniques

Week 2: Data Preparation and Exploration Visualization Techniques

Week 3: Data Preparation and Exploration Visualization Techniques Dimension Reduction Techniques Principal Component Analysis

Week 4: Performance Metrics and Assessment Performance Metrics for Prediction and Classification

Week 5: Supervised Learning Methods Multiple Linear Regression

Week 6: Supervised Learning Methods Multiple Linear Regression

Week 7: Supervised Learning Methods Naïve Bayes

Week 8: Supervised Learning Methods Classification & Regression Trees

Week 9: Supervised Learning Methods Classification & Regression Trees

Week 10: Supervised Learning Methods Logistic Regression

Week 11: Supervised Learning Methods Logistic Regression Artificial Neural Networks

Week 12: Supervised Learning Methods and Wrap Up Artificial Neural Networks Discriminant Analysis Conclusion.



CARBON MATERIALS AND MANUFACTURING

Prof. SWATI SHARMA

Department of School of Engineering

IIT Mandi

PRE-REQUISITES : Material Science for Engineers -OR- Structure of Materials (any basic material science course with description of crystal systems taught at UG level)

INTENDED AUDIENCE : Advanced B.Tech./ M.Tech. M.E./ Ph.D. from materials/ manufacturing/ energy sciences

INDUSTRIES APPLICABLE TO : This course is of high industrial relevance. All companies manufacturing carbon-fiber composites, as well as other carbon materials will benefit.

COURSE OUTLINE :

This course is focused on the preparation and structure-property relationship of various carbon materials for the purpose of device manufacturing. The contents are designed in a such a way that each type of carbon is taught in a material-manufacturing pair. Topics pertaining to the properties of various carbon allotropes, crystallinity and hybridization, raw materials, carbon fibers and composites, carbon nanomaterials and bulk industrial carbons will be covered.

ABOUT INSTRUCTOR :

Prof. Swati Sharma is currently an Assistant Professor in the School of Engineering at the Indian Institute of Technology (IIT), Mandi, India. Prior to this, she worked as a scientist at the Karlsruhe Institute of Technology and the University of Freiburg, Germany. She obtained her M.S./ Ph.D. from the University of California, Irvine, USA in 2013 in the field of carbon-based miniaturized sensors. She completed her Bachelors degree in chemical engineering from the Birla Institute of Technology and Science, Pilani, India, and worked a research scientist at the Ranbaxy Research Laboratories. Her primary research area is carbon-based devices, including biosensors, flexible electronics and bioelectronic medicine. She has expanded her research to industrial carbon manufacturing and obtaining high-value device friendly carbon materials from the urban solid waste. Her research work has been published in various peer-reviewed journals and books. She currently teaches various materials, manufacturing and energy systems related courses at IIT Mandi.

COURSE PLAN :

Week 1: Introduction to materials and manufacturing, mathematical representation of material properties, introduction to carbon, carbon on the Earth and in outer space, carbon in technology and economy, carbon isotopes, carbon atomic structure and hybridization

Week 2: Diamond, graphite, carbyne and curved carbons, classification of carbon allotropes, conversion of one allotropic form into another, phase diagram of carbon

Week 3: Engineering carbons, graphite crystal structure, stacking faults and rhombohedral graphite, graphite ore processing, synthetic graphite production from needle coke

Week 4: Kish graphite, polymer-derived graphite, Highly Oriented Pyrolytic Graphite (HOPG), pyrolysis of gaseous hydrocarbons, kinetics of graphitization, polymer-derived carbon: coking and charring mechanism

Week 5: Microstructure of non-graphitizing carbon, glass-like carbon: introduction, properties and industrial manufacturing, pyrolysis of polymers and other solid hydrocarbons, microfabrication with glass-like carbon

Week 6: Photolithography, X-Ray and Nano-Imprint Lithography, conversion of microfabricated structure into carbon, activated carbon: introduction, properties and industrial manufacturing

Week 7: Carbon black: introduction, properties and industrial manufacturing, carbon fiber: introduction and properties, melt spinning of petroleum pitches, electrospinning and viscoelasticity

Week 8: Carbonization of polyacrylonitrile (PAN) fibers, mechanical property testing methods for carbon fibers, defects in carbon fibers, Carbon Fiber Reinforced Plastic (CFRP), machining of CFRPs

Week 9: Carbon/ carbon, carbon/ metal and carbon/ concrete composites: Manufacture and Properties, graphene: introduction and crystal structure, graphene history and nomenclature, Chemical Vapor Deposition (CVD) of graphene

Week 10: Graphene CVD parameter optimization, defects in graphene, (n,m) notations, carbon nanotube: introduction and properties, vapor phase growth of carbon nanotube

Week 11: Vapor deposited diamond, diamond-like carbon, X-Ray Diffraction analysis of carbon, Raman spectroscopy of carbon, Transmission Electron Microscopy of carbon

Week 12: Gas adsorption isotherms and surface area analysis of porous carbons, numerical problem solving, large-scale industrial applications of carbon materials, micro and nano-scale applications of carbon materials, rigid and flexible carbon devices, device characteristics and challenges, supply chain of industrial carbons, summary and overview



CHEMICAL PROCESS UTILITIES

PROF. SHISHIR SINHA

Department of Chemical Engineering
IIT Roorkee

PRE-REQUISITES : Chemical Engineering Thermodynamics, Chemical Technology, Heat Transfer

INTENDED AUDIENCE : Chemical engineering, Polymer engineering, Polymer technology, Mechanical engineering

INDUSTRIES APPLICABLE TO : Useful for all process industries, refineries, fertilizer plants, petrochemical plants specially for managers and decision makers

COURSE OUTLINE :

Importance of process utilities in a typical chemical process plant is enormous. Without fundamental knowledge of process utilities it is very difficult to survive in a chemical plant. As chemical process technology becomes more complex, chemical engineers will need a more detailed and fundamental understanding of different utilities. The course focuses on understanding the important technical fundamentals of chemical process utilities. The emphasis on the fundamentals will help the student to understand the concepts and apply them accordingly. This application requires a significant quantity of fundamental knowledge and technology

ABOUT INSTRUCTOR :

Prof. Shishir Sinha is presently working as Professor in the Department of Chemical Engineering at IIT Roorkee. He has been teaching the courses related to Process Utilities and Safety, Chemical Engineering Thermodynamics and safe Operation to Petroleum industries to undergraduate and postgraduate students for more than 12 years. Prof. Sinha has more than 20 years of academic and industrial research experience with 76 publications besides more than 77 in conference proceedings. Apart from this he has written 9 books and several book chapters. Successfully completed over 22 high impact projects and consultancies

COURSE PLAN :

Week 1: Utilities in process industries, primary & secondary and their importance.

Week 2: Heat Transfer Media : Classification, characteristic properties, selection criteria for their industrial applications

Week 3: Water : Raw water and its characteristics treatment and conditions for use in process industries, e.g. for boiler feed, cooling etc., recycling and reuse of water

Week 4: Water treatment and water resource management

Week 5: Steam Generation & Utilization : Steam generation, modern boilers, steam handling, condensate removal.

Week 6: Steam traps-classification and characteristics, condensate utilization and flash steam, Efficient steam heating systems, Safety in boiler systems.

Week 7: Air : Use of air in process in industries for conveying, drying and instrumentation; design of air receivers.

Week 8: Piping Network : Design of pipelines and piping networks for water, steam, condensate and air

Week 9: Properties of air water vapors: Cooling towers

Week 10: Pressure and Vacuum systems

Week 11: Refrigeration systems

Week 12: Refractories and insulation



CLASSICAL SOCIOLOGICAL THEORY

PROF. R. SANTHOSH

Department of Humanities and Social Sciences
IIT Madras

INTENDED AUDIENCE : Undergraduate as well as postgraduate students of sociology, aspirants of competitive examinations and general public who are interested in the discipline of sociology.

COURSE OUTLINE :

This course introduce students to the formative period of the discipline of sociology the socio-cultural and intellectual factors behind the emergence of the discipline. The course offers a comprehensive analysis of key theorists such as Karl Marx, Emile Durkheim, and Max Weber who are widely considered as the stalwarts in classical sociological theory. It explains how the theoretical concerns of these scholars laid foundation to the subsequent development of sociology as a distinct social science discipline with clear theoretical as well as methodological foundations. The course enables students to develop sociological perspective and theoretical insights through a systematic analysis of the key theorists of the discipline.

ABOUT INSTRUCTOR :

Prof. R. Santhosh teaches sociology at the Department of Humanities and Social Sciences, IIT Madras. He specializes in field of sociology of religion, focusing on Hindu and Islamic religiosity in the late modern contexts in India.

COURSE PLAN :

Week 1: Introduction to sociology; uniqueness of sociological perspective

Week 2: Historical context of the emergence of Sociology: European Enlightenment

Week 3: August Comte, Herbert Spencer and early thinkers of modernity

Week 4: Karl Marx

Week 5: Karl Marx

Week 6: Emil Durkheim

Week 7: Emil Durkheim

Week 8: Max Weber

Week 9: Max Weber

Week 10: GH Mead

Week 11: Classical theory and methodological orientations in sociology

Week 12: Sociology and modernity: wrapping up and conclusion



Cloud Computing

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE,ECE,EE

PREREQUISITES : Basics of Computer Architecture and Organization, Networking

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE:

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

ABOUT THE INSTRUCTOR:

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN:

- Week 1:** Introduction to Cloud Computing
- Week 2:** Cloud Computing Architecture
- Week 3:** Service Management in Cloud Computing
- Week 4:** Data Management in Cloud Computing
- Week 5:** Resource Management in Cloud
- Week 6:** Cloud Security
- Week 7:** Open Source and Commercial Clouds, Cloud Simulator
- Week 8:** Research trend in Cloud Computing, Fog Computing
- Week 9:** VM Resource Allocation, Management and Monitoring
- Week 10:** Cloud-Fog-Edge enabled Analytics
- Week 11:** Serverless Computing and FaaS Model
- Week 12:** Case Studies and Recent Advancements



DATA ANALYTICS WITH PYTHON

PROF. A RAMESH

Department of Management Studies
IIT Roorkee

INTENDED AUDIENCE : Management, Industrial Engineering and Computer Science Engineering Students

INDUSTRIES APPLICABLE TO : Any analytics company

COURSE OUTLINE :

We are looking forward to sharing many exciting stories and examples of analytics with all of you using python programming language. This course includes examples of analytics in a wide variety of industries, and we hope that students will learn how you can use analytics in their career and life. One of the most important aspects of this course is that you, the student, are getting hands-on experience creating analytics models; we, the course team, urge you to participate in the discussion forums and to use all the tools available to you while you are in the course!

ABOUT INSTRUCTOR :

Prof. Ramesh Anbanandam graduated in Production Engineering from Madras University, Chennai. He did his post-graduation from National Institute of Technology, Trichy. He later earned his Ph.D. in Supply Chain Management from Indian Institute of Technology Delhi. His professional interest includes Humanitarian Supply Chain Management, Operations Management, Operations Research, Healthcare Waste Management, Sustainable Multi-model and Freight Transportation, Transportation Asset Management and Advanced Data Analytics using Python and R-programming. He has published various research articles in reputed journals. He was also awarded Emerald Literati Award for Excellence under "Highly Commended Research Paper in the Year 2011 and 2016" in the field of Supply Chain Management.

COURSE PLAN :

Week 1: Introduction to data analytics and Python fundamentals

Week 2: Introduction to probability

Week 3: Sampling and sampling distributions

Week 4: Hypothesis testing

Week 5: Two sample testing and introduction to ANOVA

Week 6: Two way ANOVA and linear regression

Week 7: Linear regression and multiple regression

Week 8: Concepts of MLE and Logistic regression

Week 9: ROC and Regression Analysis Model Building

Week 10: χ^2 Test and introduction to cluster analysis

Week 11: Clustering analysis

Week 12: Classification and Regression Trees (CART)



DATA STRUCTURE AND ALGORITHMS USING JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++/Java, data structures and algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines, namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. For developing large software, software developers should have enough proficiency of data structures and algorithms. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of data structures and algorithms and how the same can be implemented using Java programming language. The participants of the proposed course will be able to improve their skills, to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Dr. Samanta currently works as a faculty member at the Department of Computer Science & Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: 1D array, list and vector, 2D matrices and tables of objects

Week 2: Java implementation of 1D and 2D arrays and its operations

Week 3: Linked lists and its various operations, stack and queue

Week 4: Java implementation of linked lists, stack and queue

Week 5: Binary trees: Representation and operations. Variations of binary tree: Binary search tree, Height balanced search tree, Heap tree

Week 6: Java implementation of binary trees and its variations

Week 7: Graph : Structure, representation and operations

Week 8: Java implementations of graph data structures

Week 9: Algorithms (Part-I): Searching and sorting algorithms

Week 10: Java implementation of Part-I algorithms

Week 11: Algorithms (Part-II): Greedy algorithms, shortest path algorithms

Week 12: Java implementation of Part-II algorithms



Deep learning - IIT Ropar

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

PROF. PADMAVATI

Punjab Engineering College (Deemed To Be University)
Department of Computer Science & Engineering

INTENDED AUDIENCE: Any Interested Learners

PRE-REQUISITES : Working knowledge of Linear Algebra, Probability Theory. It would be beneficial if the participants have done a course on Machine Learning.

COURSE OUTLINE :

Deep Learning has received a lot of attention over the past few years and has been employed successfully by companies like Google, Microsoft, IBM, Facebook, Twitter etc. to solve a wide range of problems in Computer Vision and Natural Language Processing. In this course we will learn about the building blocks used in these Deep Learning based solutions. Specifically, we will learn about feedforward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms. We will also look at various optimization algorithms such as Gradient Descent, Nesterov Accelerated Gradient Descent, Adam, AdaGrad and RMSProp which are used for training such deep neural networks. At the end of this course students would have knowledge of deep architectures used for solving various Vision and NLP tasks

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

Prof. Padmavati received B.E degree in Computer Science & Engineering with distinction from PDACE, Gulbarga, V.T.U, Belgaum, Karnataka, M.E. degree in Computer Science & Engineering and Ph.D from Punjab Engineering College (Deemed to be University), Chandigarh. Currently, she is working as Assistant Professor at Punjab Engineering College (Deemed to be University), Chandigarh, India. She has been teaching this course since two years for M.Tech students. She has also offered courses like Data structure, Analysis and design of algorithms, Object oriented programming, Research methodology, and Wireless sensor networks. Her research interests are in the areas of Wireless sensor networks, IoT, machine learning and deep learning. Her current research projects include "Classification of Parkinson's disease using machine learning algorithms", "Major depressive disorder using EEG Signal", and "Detection of neurological disorder - Epilepsy using EEG Signals".

COURSE PLAN :

Week 1: History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron

Week 2: Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent

Week 3: Feed Forward Neural Networks, Back propagation

Week 4: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD

Week 5: Principal Component Analysis and its interpretations, Singular Value Decomposition

Week 6: Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders

Week 7: Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation

Week 8: Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

Week 9: Learning Vectorial Representations Of Words

Week 10: Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet

Week 11: Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Week 12: Encoder Decoder Models, Attention Mechanism, Attention over images



DESIGN, TECHNOLOGY AND INNOVATION

PROF. B.K.CHAKRAVARTHY

Department of Design Engineering
IIT Bombay

INTENDED AUDIENCE : Open for all

COURSE OUTLINE :

The course on Design Technology and Innovation portrays innovation as it weaves together a multitude of domains like design, technology, humanities and management. Through the span of 8 weeks, we have professors from various departments who will narrate their stories of how they took their research to innovation for the benefit of the community at large. The initial lectures focus on establishing the methodology of innovation by showcasing the collaborative model of innovation and the Chakku's 7 Concerns which forms the backbone of the innovation process. As the professors walk you through their innovation success stories, you will be able to learn and understand the pitfalls of innovation and the stages of transformation of research into innovation. Through these case studies, you will not only learn the stages of the innovation, but also learn to collaborate with different people of different disciplines. The passion with which the professors go beyond their routine to innovate will inspire you to take up innovation in your areas of work.

ABOUT INSTRUCTOR :

Prof. B. K. Chakravarthy teaches Innovation by Design at the Industrial Design Centre (IDC), IIT Bombay. He has set up the Shenoy Innovation Studio at IITB, where students and young designers are given the opportunity to work on live projects and benefit from expertise in a range of interrelated fields. Prof. Chakravarthy works closely with other academics engaged in cutting-edge research at IIT Bombay and has played a key role in translating such research into products that reach the hands of users. A Collaborative Model for New Product Innovation, an outcome of Prof. Chakravarthy's doctoral research, has had wide application in the industry. Prof. Chakravarthy has also worked frequently with government departments and occupational communities engaged in essential services.

COURSE PLAN :

Week 1 : i. Jaipur Foot - A classic innovation by Prof. B. K. Chakravarthy

ii. User Centred Helmet Design by Prof. B. K. Chakravarthy

Week 2 : Challenges of Reaching a Million Users by Prof. Chetan Solanki and Prof Jayendran V

Week 3 : i. Technology to Solution by Prof. Ramesh Singh

ii. Collaborative Excellence by Prof. B. Ravi & Prof. B. K. Chakravarthy

Week 4 : Collaborative Innovation Methods by Prof B. K. Chakravarthy

Week 5 : Learnings from Grassroot Innovation by Prof. Anil Gupta

Week 6 : Systemic Approach to Biomed Innovations by Prof. B. Ravi

Week 7 : Research to Innovation by Prof. Amaresh Chakrabarti

Week 8 : Smartcane for the Blind- A Success Story by Prof. P. V. Madhusudhan Rao



ECONOMICS OF BANKING AND FINANCE MARKETS

PROF. SUKUMAR VELLAKKAL

Department of Economic Sciences
IIT Kanpur

INTENDED AUDIENCE : Senior UG and PG Students

INDUSTRY SUPPORT : Academia, Public Policy institutions, Economic Environment Research, Consultancy and Financial firms

COURSE OUTLINE :

The course aims at providing adequate exposure to the basic concepts and policy issues related to the working of the financial markets nationally and globally. The course will cover basic economic theories related to banking and finance markets, and then will apply those to understand the working of both national and global monetary and other related economic variables. The course will follow a macroeconomic perspective and will discuss recent finance market developments and controversies. The course aim to develop the learning skills of the students in a way that they can apply their knowledge not only at the academic level but also at the managerial and leadership level in the field of financial sector.

ABOUT INSTRUCTOR :

Prof. Sukumar Vellakkal is working as Assistant Professor at Department of Economic Sciences, IIT Kanpur. Dr Vellakkal holds a PhD in economics from ISEC Bangalore. His teaching interest and expertise include macroeconomics, banking, financial economics, health economics and impact evaluation methodologies. Prior to joining IIT Kanpur, as faculty member he worked with various academic and research institutions, namely, ICRIER (New Delhi), PHFI (New Delhi), Azim Premji University Bangalore, and BITS Pilani.

COURSE PLAN :

Week 1: An overview of the financial system; debt (bond) markets

Week 2: Debt (bond) markets; interest rate determination

Week 3: Equity markets; basics of banking

Week 4: Banking sector

Week 5: Asymmetric information and the rationale for regulations of finance markets

Week 6: Asymmetric information; Conflicts of interest and rationale for regulations

Week 7: Rationale for regulations; financial crisis

Week 8: Financial crisis; central banking

Week 9: Central banking

Week 10: Central banking and monetary policy tools

Week 11: Effectiveness of policy

Week 12: Monetary policy tactics and strategies



ETHICAL HACKING

PROF. INDRANIL SENGUPTA

Dept. of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : Computer Science and Engineering / Information Technology / Electronics and Communication Engineering / Electrical Engineering

PREREQUISITES : Basic concepts in programming and networking

INDUSTRIES APPLICABLE TO : TCS, Wipro, CTS, Google, Microsoft, Qualcomm

COURSE OUTLINE

Ethical hacking is a subject that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the participants. The participants are encouraged to try and replicate the demonstration experiments that will be discussed as part of the course.

ABOUT INSTRUCTOR

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on Reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

COURSE PLAN

Week 1: Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.

Week 2: IP addressing and routing. TCP and UDP. IP subnets.

Week 3: Routing protocols. IP version 6.

Week 4: Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool.

Week 5: Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

Week 6: Introduction to cryptography, private-key encryption, public-key encryption.

Week 7: Cryptographic hash functions, digital signature and certificate, applications.

Week 8: Steganography, biometric authentication, network-based attacks, DNS and Email security.

Week 9: Packet sniffing using Wireshark and Burpsuite, password attack using Burp suite. Social engineering attacks and Denial of service attacks.

Week 10: Elements of hardware security: side-channel attacks, physical in-clinable functions, hardware trojans.

Week 11: Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution, etc. Attack on web servers: password attack, SQL injection, cross site scripting.

Week 12: Case studies: various attacks scenarios and their remedies.



FINANCIAL INSTITUTIONS AND MARKETS

PROF. JITENDRA MAHAKUD

Department of Humanities and Social Sciences
IIT Kharagpur

INTENDED AUDIENCE : Economics, Commerce and MBA Finance students

INDUSTRIES APPLICABLE TO : Financial Consulting Companies, Regulatory Bodies like RBI, SEBI, IRDA, PFRDA

COURSE OUTLINE :

This course will provide an understanding of the functions, and operations of the financial markets and institutions operating in India. It explains the role of financial system on economic development. Various conceptual issues related to risk and return, the role of regulatory bodies, mechanism of commercial banking, operations of insurance companies and mutual funds are discussed elaborately. It also describes the importance of small savings, provident funds, pension funds and credit rating agencies. The course provides a comprehensive overview and systematic evaluation of the mainstream markets of various financial instruments such as call money, bond, stock, derivatives and exchange rate.

ABOUT INSTRUCTOR :

Prof. Jitendra Mahakud is Professor of Economics and Finance at the Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur. He is also a joint faculty at the Vinod Gupta School of Management, IIT Kharagpur, in the area of finance. He obtained his PhD from the Indian Institute of Technology, Mumbai. He has published more than 50 papers in leading national and international journals. He has co-authored a book titled Financial Institutions and Markets: Structure, Growth and Innovations published by McGraw Hill Education. He has edited two books one on Advances in Research in Business and Finance (Corporate Finance) and the other on Advances in Research in Business and Finance (Investment Management). His areas of teaching and research include financial markets and institutions, corporate finance, investment management, financial economics, behavioural finance and commercial banking.

COURSE PLAN :

Week 1 : Introduction to Financial System and Economic Development
Indicators of Financial Development

Week 2 : Concepts Related to Financial Markets and Institutions

- Concept of Risk
- Concept and types of return and yield
- Asset Pricing Models
- Valuation of Assets

Week 3 : Theories of Level and Structure of Interest Rates

Week 4 : Financial Regulations and Regulatory Institutions in India
(RBI, SEBI, IRDA, PFRDA)
Operating Procedures of Monetary Policy
Corporate Governance and SEBI

Week 5 : Commercial Banking

- Role of Banks
- Banks' Financial Statement
- Banks' Computation
- International Banking
- NPA
- Risk Management in Banking

Week 6 : Other Important Financial Institutions – I
(Provident Fund, Pension Fund, Insurance Companies)

Week 7 : Other Important Financial Institutions – II
(Mutual Fund, Credit Rating Agencies, Merchant Bank, Venture Capital Funds)

Week 8 : Money Markets in India

(Call Money Market, Treasury Bill, Commercial Paper, Certificate of Deposit)

Week 9 : Bond Market

- Bond Features
- Bond Price Volatility
- Government Security Market
- Corporate Bond Market
- Public Sector Undertaking Bonds

Week 10 : Classification of Stock Market and Securities

- IPO
- Stock Exchanges
- Stock Market Indices
- Market Micro-Structure in Stock Market

Week 11 : Derivatives Market

- Types of Derivatives
- Important Concepts used in Derivatives Market
- Pricing of Futures, Options and Swaps

Week 12 : Foreign Exchange Market

- Foreign Exchange Market Structure
- Risk Management in Foreign Exchange Market
- Exchange Rate Determination
- Foreign Capital – FDI & FII
- Central Bank Intervention in Foreign Exchange Market



FUNDAMENTAL ALGORITHMS: DESIGN AND ANALYSIS

PROF. SOURAV MUKHOPADHYAY

Department of Computer Science

IIT Kharagpur

INTENDED AUDIENCE: Core, UG /PG, B.Tech/B.E./M.Tech/M.Sc.

INDUSTRIES APPLICABLE TO : IT companies

COURSE OUTLINE :

This course provides an introduction to mathematical modeling of computational problems. It covers the common algorithms, algorithmic paradigms, and data structures used to solve these problems. The course emphasizes the relationship between algorithms and programming, and introduces basic performance measures and analysis techniques for these problems.

ABOUT INSTRUCTOR :

Prof. Sourav Mukhopadhyay is an associate professor at Indian Institute of Technology Kharagpur. He has completed his B.Sc (Honours in Mathematics) in 1997 from University of Calcutta, India. He has done M.Stat (in statistics) and M.Tech (in computer science) from Indian Statistical Institute, India, in 1999 and 2001 respectively. He worked with Cryptology Research Group at Indian Statistical Institute as a PhD student and received his Ph.D. degree in Computer Science from there in 2007. He was a Research Assistant at the Computer Science department of School of Computing, National University of Singapore (NUS). He visited Inria Rocquencourt, project CODES, France and worked as a post-doctoral research fellows at the School of Computer Engineering, Nanyang Technological University (NTU), Singapore. He was a post-doctoral research fellows and a part time Lecturer with School of Electronic Engineering, Dublin City University (DCU), Ireland.

COURSE PLAN :

Week 1: Insertion Sort, Asymptotic Notation, Merge Sort, QuickSort, Divide and Conquer

Week 2: Heap Sort, Linear-time Sorting, Order Statistics

Week 3: Hashing, BST Sort, Augmenting Data Structures, Dynamic Programming

Week 4: Graphs : BFS, DFS, Prim's, Shortest Paths



FUNDAMENTALS OF AUTOMOTIVE SYSTEMS

PROF. C. S. SHANKAR RAM

Department of Design Engineering

IIT Madras

PRE REQUISITES: Rigid Body Dynamics (done in 1st year BE), Thermodynamics, Fluid Mechanics

INTENDED AUDIENCE: 3rd/4th year undergraduate and 1st year M.Tech./M.S./Ph.D. students

COURSE OUTLINE :

The objective of this course is to provide a fundamental understanding of the various systems of a typical automobile.

Course Outcomes: At the end of this course, the participant should be able to:

1. acquire fundamental knowledge of the various systems of an automobile,
2. associate the functions of each system with its design and layout, depict the various systems using simple schematics, and apply concepts learnt in core undergraduate courses to synthesize mathematical models of the various systems.

ABOUT INSTRUCTOR :

Prof. C. S. Shankar Ram is currently a professor in the Department of Engineering Design, Indian Institute of Technology Madras, Chennai, India. He received his Bachelor of Engineering (B. E.) in Mechanical Engineering from Motilal Nehru Regional Engineering College, Allahabad, India, and his M. S. and Ph. D. from Texas A&M University, USA. His research interests are in the areas of dynamics and control with applications to automotive and transportation systems. He teaches courses on Control Systems, Fundamentals of Automotive Systems and Control of Automotive Systems at IIT Madras

COURSE PLAN :

Week 1 : Course Overview, Classification of Internal Combustion Engines, Engine Components, Operation of Four Stroke Engines

Week 2 : Two Stroke Engines, Engine Cycles

Week 3 : Engine Performance, Supercharging, Combustion in Spark Ignition Engines

Week 4 : Combustion in Compression Ignition Engines, Carburetion, Fuel Introduction Systems

Week 5 : Engine Emissions, Emission Control Systems, Automotive Powertrain

Week 6 : Automotive Clutch, Transmission, Powertrain Analysis

Week 7 : Transmission Matching and Introduction to Brake System

Week 8 : Components of Brake System, Hydraulic Brake

Week 9 : Air Brake, Antilock Brake System

Week 10 : Braking Analysis, Introduction to Steering System, Manual Steering System

Week 11 : Power Steering System, Wheel Alignment, Introduction to Suspension System

Week 12 : Components of Suspension System, Dependent and Independent Suspension, Introduction to Electric and Hybrid Powertrain, Tyres.

Industrial Automation and Control - Video course

1. Lecture 1: Introduction to Industrial Automation and Control
2. Lecture 2: Architecture of Industrial Automation Systems.
3. Lecture 3: Introduction to sensors and measurement systems
4. Lecture 4: Temperature measurement
5. Lecture 5: Pressure and Force measurements
6. Lecture 6: Displacement and speed measurement
7. Lecture 7: Flow measurement techniques
8. Lecture 7: Measurement of level, humidity, pH etc
9. Lecture 8: Signal Conditioning and Processing
10. Lecture 10: Estimation of errors and Calibration
11. Lecture 3: Introduction to Process Control.
12. Lecture 4: P-- I -- D Control
13. Lecture 5: Controller Tuning.
14. Lecture 6: Implementation of PID Controllers
15. Lecture 7: Special Control Structures : Feedforward and Ratio Control.
16. Lecture 8: Special Control Structures : Predictive Control, Control of Systems with Inverse Response
17. Lecture 9: Special Control Structures : Cascade Control, Overriding Control, Selective Control, Split Range Control
18. Lecture 10: Introduction to Sequence Control, PLCs and Relay Ladder Logic
19. Lecture 11: Sequence Control : Scan Cycle, RLL Syntax
20. Lecture 12: Sequence Control : Structured Design Approach
21. Lecture 13: Sequence Control : Advanced RLL Programming
22. Lecture 14: Sequence Control : The Hardware environment
23. Lecture 15: Control of Machine tools : Introduction to CNC Machines
24. Lecture 16: Control of Machine tools : Analysis of a control loop
25. Lecture 17: Introduction to Actuators : Flow Control Valves
26. Lecture 18: Hydraulic Actuator Systems : Principles, Components and Symbols
27. Lecture 19: Hydraulic Actuator Systems : Pumps and Motors,
28. Lecture 20: Proportional and Servo Valves
29. Lecture 20: Pneumatic Control Systems : System Components
30. Lecture 21: Pneumatic Control Systems : Controllers and Integrated Control Systems



NPTEL

<http://nptel.ac.in>

Electrical Engineering

Coordinators:

Prof. S. Mukhopadhyay
Department of Electrical
Engineering IIT Kharagpur

Prof. S. Sen
Department of Electrical
Engineering IIT Kharagpur

31.Lecture 22: Electric Drives : Introduction, Energy Saving with Adjustable Speed Drives

32.Lecture 23: Step motors : Principles, Construction and Drives

33.Lecture 24: DC Motor Drives : Introduction, DC--DC Converters, Adjustable Speed Drives

34.Lecture 25: Induction Motor Drives: Introduction, Characteristics, Adjustable Speed Drives

35. Lecture 26 : Synchronous Motor Drives : Motor Principles, Adjustable Speed and Servo Drives

36. Lecture 27 : Networking of Sensors, Actuators and Controllers : The Fieldbus

37. Lecture 28 : The Fieldbus Communication Protocol

38. Lecture 29 : Introduction to Production Control Systems

39. Lecture 30 : Concluding Lecture



INDUSTRIAL SAFETY ENGINEERING

PROF. JHARESWAR MAITI

Department of Industrial & Systems Engineering
IIT Kharagpur

INTENDED AUDIENCE : All Engineering, Science, and Management Students

INDUSTRIES APPLICABLE TO :

1. Manufacturing companies like GM, Tata Motors, Tata Steel
2. Process industries such as ONGC
3. Mining industry like Coal India Limited
4. Construction companies like L&T
5. General Electric
6. R&D organizations

COURSE OUTLINE

Safety is one of the key dimensions of engineering asset management. Safety by design or prevention through design is in the core for maintaining engineering systems safe. The objective of this course is to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings. Upon completion of the course, the students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics, design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability.

ABOUT INSTRUCTOR

Prof. Jhareswar Maiti, PhD, Professor, Department of Industrial & Systems Engineering, Indian Institute of Technology (IIT), Kharagpur has more than fifteen years of teaching, research and consulting experience on Safety Analytics, Quality Analytics and Engineering Ergonomics. He has published more than 70 papers in international and national journals of repute and more than 30 papers in conference proceedings. Till date, he has supervised 11 PhD candidates to successful completion and currently supervising 8 PhD research candidates. He has been executing a number of Industry-sponsored consulting and Government as well industry funded research projects. His current UAY project entitled Safety analytics save people at work from accidents and injuries was funded by MHRD, Ministry of Steel, and Tata Steel Limited. He has organized 17 training programmes and short-term courses for industry participants. Prof Maiti has been pursuing research on safety analytics, quality analytics, and engineering ergonomics including the applications of multivariate statistical modeling since 1995. Prof Maiti excels in teaching Safety Engineering, Safety Analytics, Work System Design, Quality Engineering, Design and Analysis of Experiments (DOE), Six-sigma Fundamentals and Applications, and Applied Multivariate Statistical Modeling. A 42 lecture series on "Applied Multivariate Statistical Modeling" of Prof Maiti is available in Youtube uploaded by NPTEL (national programme on technology enhanced learning). Prof Maiti has been serving the editorial board member of several international journals of repute. Presently he is the editorial board member of Safety Science published by Elsevier Science, International Journal of Injury Control and Safety Promotion, published from Taylor & Francis, and Safety and Health at Work (SHAW) published by Elsevier Science

COURSE PLAN

- Week 1** : Introduction, key concepts, terminologies, and safety quantification, safety by design
Week 2 : Hazard identification techniques (e.g., HAZOP, FMEA, etc.)
Week 3 : Fault tree and event tree analysis (qualitative & quantitative)
Week 4 : Bow-tie and quantitative risk assessment (QRA)
Week 5 : Safety function deployment
Week 6 : Safety vs reliability – quantification of basic events (repair to failure, repair-failure-repair, and combined processes)
Week 7 : Safety vs reliability – quantification of basic events (contd.)
Week 8 : Systems safety quantification (e.g., truth tables, structure functions, minimal cut sets)
Week 9 : Human error analysis and safety
Week 10 : Accident investigation and analysis
Week 11 : Application of virtual reality
Week 12 : OSHAS 18001 and OSHMS



INNOVATION BY DESIGN

PROF. B.K. CHAKRAVARTHY

Department of Design Engineering
IIT Bombay

INTENDED AUDIENCE : Open to all

COURSE OUTLINE :

In today's world, there are so many challenges and problems that need to be addressed. In this situation, innovation is what provides the solution that will benefit the maximum number of users. And such innovation is often enabled by design. This course familiarizes you with the concept of "innovation" and the journey of a design idea from the identification of a problem to a final solution that has a positive impact on a large community of users. Through case studies that focus on the "seven concerns of innovation", you learn how the innovation process requires empathy, meticulous effort, constant user interaction and effective collaboration.

ABOUT INSTRUCTOR :

Prof. B. K. Chakravarthi teaches Innovation by Design at the Industrial Design Centre (IDC), IIT Bombay. He has set up the Shenoy Innovation Studio at IITB, where students and young designers are given the opportunity to work on live projects and benefit from expertise in a range of interrelated fields. Prof. Chakravarthi works closely with other academics engaged in cutting-edge research at IIT Bombay and has played a key role in translating such research into products that reach the hands of users. A Collaborative Model for New Product Innovation, an outcome of Prof. Chakravarthi's doctoral research, has had wide application in the industry. Prof. Chakravarthi has also worked frequently with government departments and occupational communities engaged in essential services.

COURSE PLAN :

Week 1 :

- Module 1 – Introduction,
- Module 2 - First C: The Cause

Week 2 :

- Module 3 - Second C: The Context,
- Module 4 - Third C: The Comprehension

Week 3 :

- Module 5 - Fourth C: The Check,
- Module 6 - Fifth C: The Conception

Week 4 :

- Module 7 - Sixth C: The Crafting,
- Module 8 - Seventh C: The Connection



INTRODUCTION TO AEROSPACE ENGINEERING-FLIGHT

PROF. RAJKUMAR S. PANT

Department of Aerospace Engineering
IIT Bombay

INTENDED AUDIENCE : Any discipline of Engineering, who are interested in the subject

INDUSTRY SUPPORT : DRDO, HAL, NAL, IAF

COURSE OUTLINE :

The aim of this course is to provide a general overview of the field of Aeronautical Engineering to interested students. The course will consist of ten Capsules, each consisting of two Lectures. Each Lecture will cover a specific concept or area relevant to the subject. An attempt will be made to cover the contents in an interesting manner, by a judicious use of a mix of powerpoint presentations, in-class activities, quizzes, innovative and hands on assignments that will not only increase the awareness of the students, but also satiate their curiosity and desire to know more about the various concepts related to the subject.

ABOUT INSTRUCTOR :

Prof. Rajkumar S. Pant has Bachelors, Masters and Ph.D. degrees in Aerospace Engineering. His areas of specialization include Aircraft Conceptual Design, Air Transportation, and Optimization. He has been a member of faculty of Aerospace Engineering Department at the Indian Institute of Technology Bombay since December 1989. Prof. Pant is an alumnus of College of Aeronautics, Cranfield University, UK, where he earned his Ph.D. under Commonwealth Scholarship Scheme, IIT Madras, where he did his Masters in Aeronautical Engineering, and PEC Chandigarh where he underwent his undergraduate studies in Aeronautical Engineering. He has also worked for five years in Hindustan Aeronautics Limited in the Design & Engineering Department at Kanpur (3.5 years) and Nasik (1.5 years) Divisions. He has published and presented ~ 220 scientific papers, of which ~ 170 are in international journals and conferences. He has also visited several top ranking institutes and universities all over the world. Prof. Pant was a Visiting Professor at School of Mechanical & Aerospace Engineering at Nanyang Technological University, Singapore in 2015-16, visiting faculty at Department of Aerospace & Ocean Engineering at Virginia Polytechnic Institute and State University in 2010-11, and a visiting researcher at Instituto Tecnológico de Aeronáutica, Brazil in 2012, Texas A&M University in 2011, Cambridge University in 2008, and Imperial College London in 2006. In November 2012, he was appointed as a Special Visiting Researcher under the Science Without Borders program of the Brazilian Government for three years

COURSE PLAN :

Week 1: Atmosphere and its properties

Week 2: Nomenclature of aircraft components

Week 3: Fluid Mechanics – I : Incompressible flow, Bernoulli's Equation, Coanda Effect, and Mach No..

Week 4: Fluid Mechanics –II : Viscous Flow, Boundary Layer, Pressure Measurement

Week 5: Aerodynamics – I : Airfoils, and Lift Generation Theories

Week 6: Aerodynamics – II : Critical Mach no., Types of Drag

Week 7: Propulsion : Types of Aircraft Engines

Week 8: Aircraft Performance - I : Steady Level Flight and Altitude effects

Week 9: Aircraft Performance- II : Glide, Climb, Ceilings, Turn, and Pull up

Week 10: Aircraft Longitudinal Stability, and V-n Diagram

Week 11: Aircraft Performance- III : Takeoff and Landing, Range and Endurance, Range-Payload Diagram

Week 12: Flapping Wing Aerodynamics



INTRODUCTION TO AIRCRAFT DESIGN

PROF. RAJKUMAR S. PANT

Department of Aerospace Engineering

IIT Bombay

PRE-REQUISITES : Introduction to Aerospace Engineering, Flight Mechanics

INTENDED AUDIENCE : Aeronautical Engineering, Aerospace Engineering, Mechanical Engineering and Automobile Engineering

INDUSTRIES APPLICABLE TO : HAL, NAL, Mahindra Aerospace, ADE, ADA, Airbus, Boeing

COURSE OUTLINE :

This course is designed to provide students an understanding of procedure followed in conceptual design of an aircraft, meeting the user-specified design requirements and safety considerations specified by the aircraft certification agencies. The students will be exposed to types of aircraft and their features, requirements capture, configuration selection, initial sizing, determination of aerodynamic coefficients, constraint analysis, mass break down, types of loads, V-n diagram, Operational issues (noise, emissions, Range-Payload diagram), and life cycle cost analysis. A special feature of this course will be to take the students through a complete exercise in re-sizing and of a baseline civil transport aircraft to meet a specified market requirement. This exercise will be conducted through a series of tutorials which will run all along the course to give the participants a practical feel of conceptual sizing and of an existing civil transport aircraft.

ABOUT INSTRUCTOR :

Prof. Rajkumar S. Pant has Bachelors, Masters and Ph.D. degrees in Aerospace Engineering. His areas of specialization include Aircraft Conceptual Design, Air Transportation, and Optimization. He has been a member of faculty of Aerospace Engineering Department at the Indian Institute of Technology Bombay since December 1989. Prof. Pant is an alumnus of College of Aeronautics, Cranfield University, UK, where he earned his Ph.D. under Commonwealth Scholarship Scheme, IIT Madras, where he did his Masters in Aeronautical Engineering, and PEC Chandigarh where he underwent his undergraduate studies in Aeronautical Engineering. He has also worked for five years in Hindustan Aeronautics Limited in the Design & Engineering Department at Kanpur (3.5 years) and Nasik (1.5 years) Divisions. He has published and presented ~ 220 scientific papers, of which ~ 170 are in international journals and conferences. He has also visited several top ranking institutes and universities all over the world. Prof. Pant was a Visiting Professor at School of Mechanical & Aerospace Engineering at Nanyang Technological University, Singapore in 2015-16, visiting faculty at Department of Aerospace & Ocean Engineering at Virginia Polytechnic Institute and State University in 2010-11, and a visiting researcher at Instituto Tecnológico de Aeronáutica, Brazil in 2012, Texas A&M University in 2011, Cambridge University in 2008, and Imperial College London in 2006. In November 2012, he was appointed as a Special Visiting Researcher under the Science Without Borders program of the Brazilian Government for three years.

COURSE PLAN :

Week 1: Introduction to Aircraft Design & Requirements Capture

Week 2: Design Considerations in Airliners, Cargo, and SST

Week 3: Design Considerations in GA and Military Aircraft

Week 4: Aircraft Configuration Design

Week 5: Aircraft Layout Choices

Week 6: Initial Sizing

Week 7: Estimation of Lift Coefficient

Week 8: Estimation of subsonic parasite drag coefficient

Week 9: Constraint Analysis of Military Aircraft

Week 10: Constraint Analysis of Transport Aircraft

Week 11: Aircraft Loads and V-N Diagram

Week 12: Cost Estimation in Aircraft Design



INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic knowledge of computer and internet

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engg, Industrial Engineering, Industry Professionals

INDUSTRIES APPLICABLE TO : All Industrial Sectors

COURSE OUTLINE :

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle. This course has been organized into the following modules:.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN:

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab



INTRODUCTION TO INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic programming knowledge

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engineering, Industrial Engineering

COURSE OUTLINE :

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN :

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud Computing(contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring



INTRODUCTION TO MACHINE LEARNING (TAMIL)

PROF. ARUN RAJKUMAR

Department of Computer Science
IIT Madras

INTENDED AUDIENCE: Native Tamil speaking audience (Teachers/ Undergraduate Students)

PREREQUISITES: A basic course in linear algebra/probability/programming/algorithms would be a big plus. These are not strong pre-requisites.

INDUSTRY SUPPORT: All Data centric companies including those that have core business in search/e-commerce/social-media

COURSE OUTLINE:

A short course introducing the main ideas and algorithms of Machine Learning. The goal of the course is to cover the topics at a high level so that it would act as a first course for a full fledged Machine Learning course. The course will be delivered in spoken Tamil while the technical terms discussed/exams/assignments will be in English.

ABOUT INSTRUCTOR:

Prof.Arun Rajkumar is currently an assistant professor in the department of CSE at IIT Madras. His PhD thesis was in the area of Machine Learning and his broad research interests are in the areas of Machine Learning, sequential decision making.

COURSE PLAN:

Week 1: Basics of Linear Algebra, Probability, Optimization

Week 2: Introduction to Supervised Learning - Regression; Topics - Linear Regression; Ridge Regression; LASSO

Week 3: Supervised Learning - Classification; Topics: K-NN, Decision Tree.

Week 4: Supervised Learning - Classification; Topics: Naive Bayes.

Week 5: Supervised Learning - Logistic Regression ,Perceptron.

Week 6: Supervised Learning - Support Vector Machines

Week 7: Supervised Learning - Ensemble Methods

Week 8: Unsupervised Learning - K-means Clustering, PCA



INTRODUCTION TO PROGRAMMING IN C

PROF. SATYADEV NANDAKUMAR

Dept. of Computer Science and Engineering
IIT Kanpur

INTENDED AUDIENCE : Any interested learners.

PRE-REQUISITES : No prior programming required; mathematical maturity of a second level UG student in science or engineering.

COURSE OUTLINE :

This is a course in programming in C. No prior programming experience is assumed; however, mathematical maturity at the level of a second year science or engineering undergraduate is assumed. We emphasize solving problems using the language, and introduce standard programming techniques like alternation, iteration and recursion. We will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams.

ABOUT INSTRUCTOR :

Prof. Satyadev Nandakumar is an Assistant Professor from the Department of Computer Science and Engineering IIT Kanpur who specialises in Computable Analysis, Algorithmic Information Theory, Symbolic Dynamics. His research interests includes Theoretical Computer Science, Algorithmic Information Theory, Computable Analysis.

COURSE PLAN :

Week 01 : Introduction. Straight-Line Code. Variables, Operators, Expressions and Conditionals.

Week 02 : Loops.

Week 03 : Functions.

Week 04 : One-Dimensional Arrays and Pointers.

Week 05 : Recursion.

Week 06 : Multi-dimensional Arrays, Linked Lists.

Week 07 : Operating on Files.

Week 08 : Organizing C projects, working with multiple source directories, makefiles.



MARKETING RESEARCH AND ANALYSIS

PROF. J.K. NAYAK

Department of Management
IIT Roorkee

INTENDED AUDIENCE : Corporate executives, U.G, P.G and PhD students from the management discipline. It is a core as well as elective course for UG and PG.

INDUSTRIES APPLICABLE TO : All Industries both in Public and Private space, academic institutions and Research organizations

COURSE OUTLINE :

Marketing research is involved with the linking of the manufacturers, intermediaries and the customers through information. It helps in identifying the recent trends in habits and behaviours of consumers through a research process. Some of the key applications of this study is to create a better product, decide the right price, distribution system and the promotional mechanism to attract customers and make a difference within the competition. It uses research tools in understanding the customer and segmenting the market. Some of the research tools are qualitative and quantitative in nature as well. Some of the frequently used techniques are like focus group study, TAT, projective techniques, regression analysis, factor and cluster analysis, discriminant analysis, structural equation modeling, multidimensional scaling and conjoint analysis etc. and other multivariate techniques.

ABOUT INSTRUCTOR :

Prof. Jogendra Kumar Nayak is the Associate Professor in Marketing in the Department of Management Studies, Indian Institute of Technology Roorkee. He is a Ph.D. degree holder from the Indian Institute of Technology Kharagpur. He teaches marketing research in both spring and autumn semesters in IIT Roorkee. Along with it, he also teaches industrial marketing. He also stands credited for authoring a book on Retail Management which has been published by a reputed publishing house like Cengage. He has publications in most of the publishing houses such as Elsevier, Emerald, Sage and Taylor and Francis. His major research areas are Industrial Marketing, Consumer Behavior, and Tourism Management. He regularly conducts a workshop titled "Data Analysis for Research and Publication" which is attended by participants from educational institutes, Govt. organizations and industry as well.

COURSE PLAN :

Week 1: Introduction to Marketing Research, Defining Research Problem, Developing, Research Approach, Research Design, Qualitative Research.

Week 2: Qualitative Research, Projective Technique, Case Study, Descriptive Research, Design, Primary & Secondary Data, Research Error, Measurement & Scaling.

Week 3: Scale Development, Questionnaire & Form Design, Causal Research, Experimental Design & Sampling.

Week 4: Sampling, Hypothesis Development, Type I & Type II Errors, Data Preparation, Hypothesis Testing.

Week 5: Hypothesis Testing, Cross Tabulation, Correlation & Regression, Factor Analysis.

Week 6: Factor Analysis, SEM & CFA, Cluster Analysis.

Week 7: Cluster Analysis, Discriminant Analysis, Researching Rural Market, International Marketing Research.

Week 8: Ethics, Report Preparation, Multi Dimensional Scaling, Conjoint Analysis.



MATLAB PROGRAMMING FOR NUMERICAL COMPUTATION

PROF. NIKET KAISARE

Department of Chemical Engineering
IIT Madras

INTENDED AUDIENCE

This is an introductory course, targeted towards scientists and engineers interested in using MATLAB programming for numerical computations. Examples taken in this course will be of generic interest to a wide range of students. This is a hands-on (like a laboratory) elective course. Intended audience include undergraduates, people with BE / ME / MS / MSc degrees; The course may be useful for PhD students also.

PRE-REQUISITES

The students for this course are expected to know basics of linear algebra and calculus, at 12th standard level. These are also covered in Introductory Math course for Engineers (typically done in first year).

This course is intended to be practical (laboratory) course. Some prior background in programming will be useful, though not required. Likewise, students who have either completed or are currently doing “Numerical Methods” / “Computational Techniques” will find it easier to follow this course. Theoretical aspects of methods covered in this lab can be found in NPTEL course on "Numerical Methods for Engineers" (<https://nptel.ac.in/courses/127106019>).

ABOUT THE COURSE

MATLAB is a popular language for numerical computation. This course introduces students to MATLAB programming, and demonstrate its use for scientific computations. The basis of computational techniques are expounded through various coding examples and problems, and practical ways to use MATLAB will be discussed. By the end of this course, students would:

1. Learn basics of MATLAB programming
2. Get introduced to numerical methods for engineering problems
3. Will be able to use MATLAB to solve computational problems

SOFTWARE USED:

We will use MATLAB in this course. Course lectures, practice problems and assignments will use MATLAB.

MATLAB Online is a fully-featured browser-based version of MATLAB. With support from MathWorks, access to MATLAB Online is provided free-of-cost to all the enrolled students for the duration of this course.

ABOUT THE COURSE:

Prof. Niket Kaisare is a Professor of Chemical Engineering in IIT-Madras. He works in the area of modeling, design and control for energy applications. He has over ten years of research/teaching experience in academia, and three-year experience in Industrial R&D. He uses computational software, including MATLAB, FORTRAN, Aspen and FLUENT extensively in his research and teaching.

Faculty web-page: <http://www.che.iitm.ac.in/~nkaisare/>

COURSE PLAN:

The course will be covered in twelve modules. Various aspects of MATLAB programming for numerical computation will be covered in these modules, with each module dedicated to an equivalent numerical topic. There will be self-study problems and graded assignment problems given each week, which are to be solved using MATLAB. The course plan is:

1. Introduction to MATLAB Programming: This module will introduce the students to MATLAB programming through a few examples. Students who have used MATLAB are still recommended to do this module, as it introduces MATLAB in context of how we use it in this course
2. Building your Code with MATLAB: This module covers MATLAB Script and Function files, loops, execution control, best-practices for MATLAB functions and tips on how to debug a MATLAB code.
3. Approximations and Errors: Taylor's / Maclaurin series expansion of some functions will be used to introduce approximations and errors in computational methods
4. Linear Equations: The focus of this module is to do a quick introduction of most popular numerical methods in linear algebra, and use of MATLAB to solve practical problems.
5. Nonlinear Equations: After introduction to bisection rule, this module primarily covers Newton-Raphson method and MATLAB routines `fzero` and `fsolve`.
6. Numerical Differentiation and Integration: Methods of numerical differentiation and integration, trade-off between truncation and round-off errors, error propagation and MATLAB functions for integration will be discussed.
7. Ordinary Differential Equations (ODE): Explicit ODE solving techniques in single variable will be covered in this module.
8. ODE-IVP in Multiple Variables: This module will cover ODE solving in multiple variables, stiff systems, and practical problems. The importance of ODEs in engineering is reflected by the fact that two modules are dedicated to ODEs.
9. Regression and Interpolation: The focus will be practical ways of using linear and nonlinear regression and interpolation functions in MATLAB.
10. ODE-BVP and DAE: ODE-Boundary Value Problems; Differential Algebraic Equations
11. Partial Differential Equations (PDEs): Practical ways of solving Hyperbolic and Parabolic PDEs
12. Bringing it all together: Optimization and Solving interesting computational problems by bringing together multiple concepts



MECHANICS OF FIBER REINFORCED POLYMER COMPOSITE STRUCTURES

PROF. DEBABRATA CHAKRABORTY

Department of Mechanical Engineering
IIT Guwahati

PRE-REQUISITES : No specific pre-requisite. Fundamental knowledge of Strength of Materials / Solid Mechanics.

INTENDED AUDIENCE : Undergraduate and postgraduate students of Mechanical/ Civil/ Aerospace Engineering and similar branches; Faculty members associated with Mechanical/ Civil/ Aerospace Engineering; Practicing engineers associated with design of composite structures.

INDUSTRIES APPLICABLE TO : DRDO, ISRO, NAL

COURSE OUTLINE :

This is introductory course on Mechanics of Fiber Reinforced Composite Structures. One course is basically aimed at introducing the students of mechanical/civil engineering streams to the basics of design and analysis of structural components made of FRP composites. The contents of the course is so designed that it requires the first course on strength of materials/solid mechanics as a prerequisite which is anyway a core course for mechanical/civil undergraduates. It introduces the students first to the basic mechanics (stress strain and load deformation relations) of fiber composites, possible failure modes and corresponding failure theories proposed. Next, the course introduces the design and analysis using those concepts along with the design of some components made of such materials. At the end a few topics of slightly advanced nature (for UG students) are kept for brief introduction only.

ABOUT INSTRUCTOR :

Prof. Debabrata Chakraborty is currently a Professor in the Department of Mechanical Engineering of the Indian Institute of Technology Guwahati. He did his BE(Hons) in Mech Engg from Gauhati University in 1987 and MTech and PhD in Mechanical Engineering from IIT Kharagpur in 1993 and 1999 respectively. His research area is stress analysis of FRP composite structures with specific interest in design optimization of laminated structures and analysis of laminated composites with internal flaws. Dr Chakraborty has more than 25 years of experience in teaching and research. He has been a faculty member of Mechanical Engineering Department at IIT Guwahati since 1999 and guided nine PhD students and more than 50 Masters students in the broad area of design and analysis of FRP composite structures and taught the course on Composite Materials to both UG and PG students several times.

COURSE PLAN :

Week 1: Introduction to FRP Composites

Week 2: Review of Elasticity

Week 3: Macromechanics of Lamina - I

Week 4: Macromechanics of Lamina -II

Week 5: Micromechanics of Lamina-I

Week 6: Micromechanics of Lamina-II

Week 7: Elastic Behaviour of Laminates - I

Week 8: Elastic Behaviour of Laminates - II

Week 9: Failure analysis of Laminates

Week 10: Design examples

Week 11: Interlaminar stresses

Week 12: Transverse Deflection, Buckling and Free vibration of Laminated Plates



MEDICINAL CHEMISTRY

PROF. HARINATH CHAKRAPANI

Department of Chemistry
IISER Pune

PRE-REQUISITES : Any student who has done basic organic chemistry and has some knowledge of biochemistry with an interest in drug discovery

INTENDED AUDIENCE : Third year undergraduates of B.Sc. Chemistry; M.Sc. Chemistry students and doctoral students

INDUSTRIES APPLICABLE TO : Companies in the pharmaceutical sector may recognize and value this course.

COURSE OUTLINE :

The main objective of this course is to familiarize students with the fundamental concepts of drug discovery and development. The course is intended for students who have a background in chemistry and interested in the process of drug discovery. The intended outcome is to train students on various aspects of new drug discovery/development, drug screening, target identification, lead discovery, optimization and the molecular basis of drug design and drug action.

ABOUT INSTRUCTOR :

Prof. Harinath Chakrapani completed his undergraduate and post-graduate studies in Chemistry from Loyola College and Indian Institute of Technology Madras, respectively. He moved to Duke University, USA to pursue his doctoral studies and after post-doctoral research stints at Wake Forest University and the National Cancer Institute, USA, he joined IISER Pune in July 2009 and is currently Associate Professor.

COURSE PLAN :

Week 1: An overview of drugs and drug targets; structure of a cell; intermolecular binding forces; classification of drugs.

Week 2: Principles of enzyme structure, catalysis and inhibition in drug discovery: enzyme catalysis and inhibition in drug discovery;

Week 3: Principles of enzyme structure, catalysis and inhibition in drug discovery: Enzyme mechanisms overview; case

Week 4: Receptors function and ligand binding interactions; Ion channel receptors; kinase-linked receptors; G-Protein coupled receptors, drug-receptor interaction; dose-response curves; case

Week 5: Nucleic acids structure and function; DNA Interactive agents and chemotherapy: DNA binding agents; intercalation and alkylation; DNA strand breakers; case studies

Week 6: Synthetic methods in medicinal chemistry: Combinatorial and parallel synthesis: solid phase techniques, mix and split method in combinatorial synthesis;

Week 7: Lead discovery; Bioassays; drug targets; Lead Modification; optimization; pharmacophore; homology; bioisostere; chain branching;

Week 8: Electronic effects; Lipophilicity; Structure-Activity Relationships; Quantitative-structure activity relationships (QSAR).

Week 9: Drug metabolism and pharmacology: Analytical methods in metabolism; Phase I and II transformations; ADME; bioavailability; pre-clinical and clinical development; therapeutic index and therapeutic window.

Week 10: Prodrugs and drug delivery systems: Use of prodrug systems; prodrugs for stability, solubility and slow release; overview of drug delivery

Week 11: Drug resistance mechanisms and synergism: Mechanisms of drug resistance;

Week 12: circumventing drug resistance; drug synergy



NATURAL GAS ENGINEERING

PROF. PANKAJ TIWARI

Department of Chemical Engineering
IIT Guwahati

INTENDED AUDIENCE : Under graduate and post graduate students professional practitioner in the discipline of Chemical Engineering. Petroleum Engineering, Mechanical Engineering, Energy

PRE-REQUISITES : Bachelor Degree in any Engineering discipline

INDUSTRIES APPLICABLE TO : Petroleum Industries/companies: ONGC, OIL, GAIL, IOCL, etc.

COURSE OUTLINE :

The field of natural gas engineering is very much important for petroleum engineers specializing in gas processing technology. The course outlines an optimal balance between natural gas production, natural gas processing and gas transportation. An extensive treatise on natural gas engineering, both upstream and gas refining processes with key equipment and facility design will be covered. This course will also highlight the current status of production of natural gas through unconventional sources/technics and the applications of natural gas.

ABOUT INSTRUCTOR :

Prof. Pankaj Tiwari is serving as Assistant Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati since Aug 2012. He has received doctoral degree from University of Utah, USA (2012) and Master of Technology from Indian Institute of Technology Kanpur, India (2006). He also worked at General Electric, Plastic division at JFWTC Bangalore (2007) on developing the monomer for high performance polymer (HPP). He has taught Natural Gas Engineering as an elective course to UG, PG and PHD students at IIT Guwahati for three consecutive years (2013, 2014 and 2015).

COURSE PLAN :

- Week 01 :** Introduction, Gas Production: Upstream, Reservoir- Well Completion
- Week 02 :** Properties of Natural Gas: Phase Behavior
- Week 03 :** Well inflow performance relationship (IPR), Skin factor, Productivity Index, Gas well testing
Deliverability : Nodal Analysis.
- Week 04 :** Wellbore Performance: TPR Curve, Single Phase & Multi Phase flow, Choke Performance: CPR Curve, Sonic and Subsonic Flow, Well Deliverability: Nodal Analysis
- Week 05 :** Natural Gas Production: Downstream, Surface Facilities, Principle of Separator, Design of Separator: Vertical, Horizontal; Two Phase Separation, Three Phase Separation
- Week 06 :** Natural Gas Processing: Dehydration of Natural Gas, Design of Dehydration, Sweetening Processes, Compressor design and energy calculation
- Week 07 :** Transportation and Measurement, Pipeline Design
- Week 08 :** Flow through pipeline, issues and solutions, Unconventional Production of Natural Gas: Shale Gas, Gas Hydrates, Coal bed Methane, Oil Shale, Pyrolysis of Carbonaceous Materials etc..



NATURAL LANGUAGE PROCESSING

PROF. PAWAN GOYAL

Department of Computer Science and Engineering

IIT Kharagpur

PRE-REQUISITES : Basic knowledge of probabilities for the lectures and python for programming assignment

INDUSTRIES APPLICABLE TO : Microsoft Research, Google, Adobe, Xerox, Flipkart, Amazon

COURSE OUTLINE :

This course starts with the basics of text processing including basic pre-processing, spelling correction, language modeling, Part-of-Speech tagging, Constituency and Dependency Parsing, Lexical Semantics, distributional Semantics and topic models. Finally, the course also covers some of the most interesting applications of text mining such as entity linking, relation extraction, text summarization, text classification, sentiment analysis and opinion mining.

ABOUT INSTRUCTOR :

Prof. Pawan Goyal is an Assistant Professor at the Department of Computer Science and Engineering, IIT Kharagpur. His research interests include Natural Language Processing, Text Mining, Information Retrieval and Sanskrit Computational Linguistics. He has published around 75 research papers in international conferences and journals. He has published in various top-tier conferences and journals including ACL, NAACL, EMNLP, SIGIR, KDD, CIKM, JCDL, ICWSM, CSCW, Coling, IEEE and ACM transactions. Prior to joining IIT Kharagpur, he received his B. Tech. degree in Electrical Engineering from IIT Kanpur in 2007 and his Ph.D. degree in the faculty of Computing and Engineering from University of Ulster, UK in 2011. He was then a Post Doctoral Fellow at INRIA Paris Rocquencourt.

COURSE PLAN :

Week 1: Introduction and Basic Text Processing

Week 2: Spelling Correction, Language Modeling

Week 3: Advanced smoothing for language modeling, POS tagging

Week 4: Models for Sequential tagging – MaxEnt, CRF

Week 5: Syntax – Constituency Parsing

Week 6: Dependency Parsing

Week 7: Distributional Semantics

Week 8: Lexical Semantics

Week 9: Topic Models

Week 10: Entity Linking, Information Extraction

Week 11: Text Summarization, Text Classification

Week 12: Sentiment Analysis and Opinion Mining



PATENT DRAFTING FOR BEGINNERS

PROF. FEROZ ALI

Department of Management Studies

IIT Madras

INDUSTRIES APPLICABLE TO : Law Firms, LPOs, knowledge-based industries etc

INTENDED AUDIENCE : Anyone interested in patent drafting

PRE-REQUISITES : No pre-requisites for this course. But students may benefit from the course "Patent Law For Engineers and Scientists"

COURSE OUTLINE :

Patent specifications — the documents which encompass the patent right in a technological invention are techno-legal documents created at the interface of science and law. Unlike technical writing, patent law requires drafting patent specifications to satisfy certain requirements. This course is designed to enable beginners without any prior knowledge on patent drafting to draft patent specifications on their own. The course will cover the fundamental principles of patent drafting and discuss in detail the concepts in patent law in the context of patent drafting.

ABOUT INSTRUCTOR :

Prof. Feroz Ali is the Chair Professor on Intellectual Property Rights (IPR) at the Indian Institute of Technology (IIT) Madras. He teaches intellectual property laws and business laws. He is the author of three books on patent law. He is a practicing advocate at the Madras High Court. He litigates and counsels in intellectual property law, corporate law and competition law but his primary focus has remained in patent law. He has appeared before the Supreme Court, the High Courts, Intellectual Property Appellate Board and the Patent Offices

COURSE PLAN :

Week 1 : Invention as a solution to an unsolved Problem

Week 2 : Drafting a Claim

Week 3 : Types and Arrangement of Claims

Week 4 : Structure of the Patent Specification



PATENT LAW FOR ENGINEERS AND SCIENTISTS

PROF. FEROS ALI

Department of Management Studies
IIT Madras

PRE-REQUISITES : Background degree in Science or Technology is preferable. Students who enroll for this course may also benefit from the course "Patent Drafting for Beginners"

INTENDED AUDIENCE : Engineering and Science Graduates and Students

INDUSTRIES APPLICABLE TO : Would be beneficial for candidates preparing for the Patent Agent Examination

COURSE OUTLINE :

The course shall give an in-depth understanding of patent law to engineers and scientists. This course will help person with a science background to understand the fundamentals of patent law, know the requirements of patentability, learn how to read and interpret patent specifications, analyze patent office procedures and court cases and develop the basic understanding for drafting a patent specification. This course will cover the syllabus of Paper 1 of the Patent Agent Examination conducted by the Intellectual Property Office, Government of India.

ABOUT INSTRUCTOR :

Prof. Feroz Ali is the Chair Professor on Intellectual Property Rights (IPR) at the Indian Institute of Technology (IIT) Madras. He teaches intellectual property laws and business laws. He is the author of three books on patent law. He is a practicing advocate at the Madras High Court. He litigates and counsels in intellectual property law, corporate law and competition law but his primary focus has remained in patent law. He has appeared before the Supreme Court, the High Courts, Intellectual Property Appellate Board and the Patent Offices

COURSE PLAN :

Week 1: Introduction to the Indian Patent System Patent Laws as Concepts; Understanding the Patents Act, 1970; Understanding the Patents Rules, 2003; Preliminary Sections; Preliminary Rules; What's New in the Patents (Amendment) Rules, 2016; Easy way to read the Patents Act and Rules

Week 2: Patentability of Inventions Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; Person Skilled in the Art

Week 3: Patent Specification Provisional and Complete Specifications; Structure of a Patent Specification—Title, Abstract, Description, Claims, etc.; Reading a Patent Specification—Fair basis, Enabling Disclosure, Definiteness, Priority; Introduction to Patent Drafting

Week 4: Patent Prosecution: Patent Applications Patent Application—Who Can Apply, True and First Inventor, How to Make a Patent Application, What to include in a Patent Application, Types of Patent Applications, Patents of Addition, Dating of Application;

Week 5: Patent Prosecution: Publication and Examination - I Publication of Application; Request for Examination; Examination of Application—First Examination Report

Week 6: Patent Prosecution: Publication and Examination – II Expedited Examination of Application; Search for Anticipation—Procedure, withdrawal of Application; Consideration of Report of Examiner

Week 7: Patent Prosecution: Powers of Controller Powers of Controller—Examination Stage, Consideration of report by examiner, Refuse or Amend Applications, Division of Applications, Dating of Application, Anticipation, Potential Infringement; Putting Applications in Order; Amendments during Prosecution

Week 8: Patent Prosecution: Opposition Pre-grant opposition; Post-grant opposition; Wrongful obtaining of invention; Mention of Inventor; Opposition in General.

Week 9: Patent Prosecution: Practice at the Patent Office- I; Secrecy Provisions; Grant of Patents; Rights Conferred by Grant; Rights of Co-Owners; Term of Patent; Restoration of Lapsed Patents;

Week 10: Patent Office and Patent Prosecution, Surrender; Revocation—Grounds for Revocation; Register of Patents, Patent Office and its Establishment; Patent Agents; Use and Acquisition by Government; Penalties.

Week 11: Compulsory Licensing Compulsory Licensing—Working of Patents, Grounds for Grant of Compulsory License, Revocation; Patent Licensing;

Week 12: Patent Enforcement, International Arrangements and Other Miscellaneous Provisions Intellectual Property Appellate Board; Declaratory Suits, Infringement Suits; International Application—Convention Application, PCT Application, Application Designating India, Multiple Priorities; PCT Timeline; Fees—Application, In Relation to Grant of Patents; Timelines, Application, Examination, Publication etc



PROBLEM SOLVING THROUGH PROGRAMMING IN C

PROF. ANUPAM BASU

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : BE/BTech in all disciplines BCA/MCA/M. Sc

INDUSTRIES APPLICABLE TO : All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Use arrays, pointers and structures to formulate algorithms and programs
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration

ABOUT INSTRUCTOR :

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing. Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN :

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching

Week 3: Conditional Branching and Iterative Loops

Week 4: Arranging things : Arrays

Week 5: 2-D arrays, Character Arrays and Strings

Week 6: Basic Algorithms including Numerical Algorithms

Week 7: Functions and Parameter Passing by Value

Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

Week 10: Structures and Pointers

Week 11: Self-Referential Structures and Introduction to Lists

Week 12: Advanced Topics



PRODUCT DESIGN AND MANUFACTURING

PROF. J. RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Innovation, better management, throughput improvements, and expansion of new technologies have led Product Design and Manufacturing as a compelling field for the students. Managing the product development process, right from idea generation to final product manufacturing has to be systematic and effective to meet the customer needs, while incorporating the time-to-market constraint as well. This course presents an overview of the product design and development process, along with the manufacturing systems aspects. The concepts Design for Manufacturing, Assembly, and Environment, and analytical tools for development, costing and manufacturing would help the students and practitioners learn to conceptualize, design, and manufacture competitively-priced quality products. Reverse Engineering, Prototyping and Simulation using soft tools are also incorporated make the students learn the advanced methods in manufacturing.

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers

Prof. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1: Introduction to product design and manufacturing

Week 2: Product design morphology

Week 3: Visual Design, and Quality Function Deployment (QFD)

Week 4: Value Engineering

Week 5: Material, and Manufacturing process selection

Week 6: Design for Manufacturing, Assembly, and Maintenance

Week 7: Design for Environment, and Quality Control

Week 8: Patenting, and Creativity

Week 9: Rapid Prototyping

Week 10: Plant Layout Design

Week 11: Computer Integrated Manufacturing

Week 12: Reverse Engineering, and Managing Competitiveness



PROGRAMMING IN JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

Week 7: Multithreaded Programming

Week 8: Java Applets and Servlets

Week 9: Java Swing and Abstract Windowing Toolkit (AWT)

Week 10: Networking with Java

Week 11: Java Object Database Connectivity (ODBC)

Week 12: Interface and Packages for Software Development



PROGRAMMING IN MODERN C++

PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Programming & Data Structure (mandatory), Programming in C (optional). Design and Analysis of Algorithms (optional)

INDUSTRIES APPLICABLE TO : Programming in C++ is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems) have a need for the same. These include –Microsoft, Samsung, Xerox, Yahoo, Oracle, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc. This course would help industry developers to be up-to-date with the advances in C++ so that they can remain at the state-of-the-art

COURSE OUTLINE :

There has been a continual debate on which programming language/s to learn, to use. As the latest TIOBE Programming Community Index for August 2021 indicates – C (13%), Python (12%), C++ (7%), Java (10%), and C#(5%) together control nearly half the programming activities worldwide. Further, C Programming Language Family (C, C++, C#, Objective C etc.) dominate more than 25% of activities. Hence, learning C++ is important as one learns about the entire family, about Object-Oriented Programming and gets a solid foundation to also migrate to Java and Python as needed. C++ is the mother of most general purpose of languages. It is multi-paradigm encompassing procedural, object-oriented, generic, and even functional programming. C++ has primarily been the systems language till C++03 which punches efficiency of the code with the efficacy of OOP. Then, why should I learn it if my primary focus is on applications? This is where the recent updates of C++, namely, C++11 and several later offer excellent depths and flexibility for C++ that no language can match. These extensions attempt to alleviate some of the long-standing shortcomings for C++ including porous resource management, error-prone pointer handling, expression semantics, and better readability. The present course builds up on the knowledge of C programming and basic data structure (array, list, stack, queue etc.) to create a strong familiarity with C++98 / C++03. Besides the constructs, syntax and semantics of C++ (over C), we also focus on various idioms of C++ and attempt to go to depth with every C++ feature justifying and illustrating them with several examples and assignment problems. On the way, we illustrate various OOP concepts. The course also covers important advances in C++11 and later released features

ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (<https://www.facebook.com/t10kt.algorithms/>) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

COURSE PLAN:

Week 1: Programming in C++ is Fun.

Week 2: C++ as Better C.

Week 3: OOP in C++.

Week 4: OOP in C++.

Week 5: Inheritance.

Week 6: Polymorphism.

Week 7: Type Casting.

Week 8: Exceptions and Templates.

Week 9: Streams and STL.

Week 10: Modern C++.

Week 11: Lambda and Concurrency.

Week 12: Move, Rvalue and STL Containers.



PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE : Students in any branch of mathematics/science/engineering, 1st year

PRE-REQUISITES : School level mathematics.

INDUSTRIES APPLICABLE TO : This course should be of value to any company requiring programming skills.

COURSE OUTLINE :

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

COURSE PLAN:**Week 1:**

Informal introduction to programming, algorithms and data structures

Downloading and installing Python

gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions

Week 2:

Python: types, expressions, strings, lists, tuples

Python memory model: names, mutable and immutable values

List operations: slices etc

Binary search

Inductive function definitions: numerical and structural induction

Elementary inductive sorting: selection and insertion sort

In-place sorting

Week 3:

Basic algorithmic analysis: input size, asymptotic complexity, $O()$ notation

Arrays vs lists

Merge sort

Quicksort

Stable sorting

Week 4:

Dictionaries

More on Python functions: optional arguments, default values

Passing functions as arguments

Higher order functions on lists: map, iter, list comprehension

Week 5:

Exception handling

Basic input/output

Handling files

String processing

Week 6:

Backtracking: N Queens, recording all solutions

Scope in Python: local, global, nonlocal names

Nested functions

Data structures: stack, queue

Heaps

Week 7:

Abstract datatypes

Classes and objects in Python

"Linked" lists: find, insert, delete

Binary search trees: find, insert, delete

Height-balanced binary search trees

Week 8:

Efficient evaluation of recursive definitions: memoization

Dynamic programming: examples

Other programming languages: C and manual memory management

Other programming paradigms: functional programming



PYTHON FOR DATA SCIENCE

PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PRE-REQUISITES : Knowledge of basic data science algorithms

INTENDED AUDIENCE : Final Year Undergraduates

COURSE OUTLINE :

The course aims at equipping participants to be able to use python programming for solving data science problems

ABOUT INSTRUCTOR :

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

COURSE PLAN :**Week 1:****BASICS OF PYTHON SPYDER (TOOL)**

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

Week 2:**Sequence data types and associated operations**

- Strings
- Lists
- Arrays
- Tuples
- Dictionary
- Sets
- Range

NumPy

- ndArray

Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

Data visualization on Toyota Corolla dataset using matplotlib and seaborn libraries

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

Control structures using Toyota Corolla dataset

1. if-else family
2. for loop
3. for loop with if break
4. while loop
5. Functions

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income



STRATEGIC SALES MANAGEMENT

PROF. SOURABH ARORA

Department of Management Studies
IIT Roorkee

PROF. KALPAK KULKARNI

Department of Management Studies
IIT Roorkee

PRE-REQUISITES : Graduates, the Course will aim at building Fundamentals of Sales Strategy at a Beginner's level

INDUSTRY SUPPORT : Anyone in Sales Profession, Sales Executives, Sales Managers across organizations will find value in the course

COURSE OUTLINE :

The ongoing rapid transformation in the business world certainly calls for a strategic approach to sales and selling management. With the ever-increasing competition and high commoditization, an effective and skilled sales force undoubtedly plays a key role in retaining and capturing markets. Given the same, the present course aims at enhancing the understanding of the learners on sales management from a much-needed practical perspective in conjunction with the case-based discussions. The course is designed to discuss selling from a strategic standpoint in a highly volatile, uncertain, complex and ambiguous business world with the key objective of preparing learners for crafting effective sales management strategies.

ABOUT INSTRUCTOR :

Prof. Sourabh Arora is an Assistant Professor in Marketing in the Department of Management Studies, Indian Institute of Technology Roorkee. He completed his Doctorate in Marketing from the Indian Institute of Technology Kharagpur. His work revolves around exploring emerging issues in sales management and retailing. He stands credited for various publishing papers in core marketing journals of repute like International Journal of Retail and Distribution Management, Marketing Intelligence and Planning and Journal of Consumer Marketing. His teaching interest primarily lies in coaching learners in the domain of retailing and sales management.

Prof. Kalpak is currently working as an Assistant Professor at the Department of Management Studies, Indian Institute of Technology Roorkee. He is a Ph.D. in Management from Shailesh J. Mehta School of Management, IIT Bombay. Dr. Kalpak's doctoral work focused on understanding the role of advertising content and consumer characteristics in driving consumers' intentions to share branded viral video advertisements. He has published research papers in reputed international journals like the Journal of Retailing and Consumer Services, Journal of Consumer Behaviour, and Journal of Consumer Marketing.

COURSE PLAN :

Week 1: Understanding Selling from a Strategic Perspective

Week 2: Crafting Strategic Sales Plan

Week 3: Strategic Selling

Week 4: Selling and Consumer Behaviour

Week 5: Strategic Approach to Sales Responsibilities, Preparation and Management

Week 6: Sales Intelligence and Analytics

Week 7: Selling in International Markets

Week 8: Emerging Trends in Sales

Characterization of Materials - Web course

COURSE OUTLINE

Characterization of materials is essential to the systematic development of new materials and understanding how they behave in practical applications. This course focuses on the principal methods required to characterize broad range of materials such as metal, alloys, semiconductors, insulators, polymers, ceramics, nanostructures etc. for their applications based on mechanical, electrical, optical, magnetic, thermal properties of materials.

The topics covers structure analysis tools, microscopy techniques, thermal analysis technique, electrical characterization, magnetic characterization, and optical spectroscopy, and other techniques for characterization of nanophase materials. The aim of this course is to provide introductory understanding of number important techniques in terms of the instrumentation, working principles, and information obtained and possible analysis of the materials.

This course is targeted towards undergraduate and postgraduate students of physics, materials science, metallurgy, energy technology, electrical engineering and electronics, polymer science and engineering etc.

Contents:

Introduction to materials and Techniques, *Structure analysis tools*: X-ray diffraction: phase identification, indexing and lattice parameter determination, Analytical line profile fitting using various models, Neutron diffraction, Reflection High Energy Electron Diffraction, and Low Energy Electron Diffraction; *Microscopy techniques*: Optical microscopy, transmission electron microscopy (TEM), energy dispersive X-ray microanalysis (EDS), scanning electron microscopy (SEM), Rutherford backscattering spectrometry (RBS), atomic force microscopy (AFM) and scanning probe microscopy (SPM); *Thermal analysis technique*: Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermogravimetric analysis (TGA); *Electrical characterization techniques*: Electrical resistivity, Hall effect, Magnetoresistance;



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Physics

Coordinators:

Dr. A. Perumal

Department of Physics IIT
Guwahati

Magnetic characterization techniques: Introduction to Magnetism, Measurement Methods, Measuring Magnetization by Force, Measuring Magnetization by Induction method, Types of measurements using magnetometers: M-H loop, temperature dependent magnetization, time dependent magnetization, Measurements using AC susceptibility, Magneto-optical Kerr effect, Nuclear Magnetic Resonance, Electron Spin Resonance; *Optical and electronic characterization techniques:* UV-VIS spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy. The interested users may also go through other similar courses such as **Materials Characterization** by Dr. S. Sankaran and Prof. Vijaya Agarwala; and **Advanced Characterization Techniques** by Dr. K. Biswas and Dr. Gurao.

COURSE DETAIL

Sl. No.	Module/ Lecture Topics	No. of Hours
1	1. Introduction Introduction to materials and Techniques	01 (01)
2	2. Structure analysis tools: X-ray diffraction	01 (02)
3	Phase identification, indexing and lattice parameter determination, Analytical line profile fitting using various models	03 (05)
4	Neutron diffraction; Reflection High energy electron Diffraction (RHEED), Low energy Electron Diffraction (LEED)	03 (08)
5	3. Microscopy techniques: Introduction to Microscopes, Optical microscopy (OM)	02 (10)
6	Transmission Electron Microscopy (TEM); Basic Electron scattering, Concepts of resolution, TEM instruments, Various imaging modes, Analysis of micrographs,	06 (16)

	Electron Energy Loss Spectroscopy	
7	Scanning Electron Microscopy, Rutherford backscattering spectrometry	02 (18)
8	Atomic Force Microscopy, Scanning Probe Microscopy	02 (20)
9	4. Thermal analysis techniques: Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermo-gravimetric analysis (TGA)	03 (23)
10	5. Electrical characterization techniques: Electrical resistivity in bulk and thin films, Hall effect, Magnetoresistance	04 (27)
11	6. Magnetic characterization techniques: Introduction to Magnetism, Measurement Methods, Measuring Magnetization by Force, Measuring Magnetization by Induction method	03 (30)
12	Types of measurements using magnetometers: M-H loop, temperature dependent magnetization, time dependent magnetization, Measurements using AC susceptibility, Magneto-optical Kerr effect, Nuclear Magnetic Resonance, Electron Spin Resonance	06 (36)
13	7. Optical characterization techniques: UV-VIS spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy	04 (40)
	Total	40

References:

1. Characterization of Materials (Materials Science and Technology: A Comprehensive Treatment, Vol 2A & 2B, VCH (1992).
2. Semiconductor Material and Device Characterization, 3rd Edition, D. K. Schroder, Wiley-IEEE Press (2006).
3. Materials Characterization Techniques, S Zhang, L. Li and Ashok Kumar, CRC Press (2008).
4. Physical methods for Materials Characterization, P. E. J. Flewitt and R K Wild, IOP Publishing (2003).
5. Characterization of Nanophase materials, Ed. Z L Wang, Willet-VCH (2000).



THE JOY OF COMPUTING USING PYTHON

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

INTENDED AUDIENCE : Any interested audience

PREREQUISITES : 10th standard/high school

INDUSTRY SUPPORT : Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!

NOC: Understanding Design Thinking & People Centred Design - Video course

COURSE OUTLINE

This is an introductory orientation to help enrollees understand the notions of Design Thinking and People Centered Design and how a PCD approach is different from traditional engineering or marketing focused approaches.

Today DT and PCD are being rapidly adopted and have achieved center stage by various industries. Students from any stream as well as professionals from various industries and levels of experience can learn these simple methods, concepts and tools. In order to master the topic however, they must actually execute a project to apply the teachings, which is not a part of this course.

Since this topic has very wide applicability, students will benefit from applying these in their projects and work thereafter, regardless of their area of work.

COURSE DETAIL

WeekNo.	Topics
1.	INTRODUCTION and PROBLEM DISCOVERY Intro to Design Thinking, People Centered Design & Evoking the 'right problem'
2.	RESEARCH AND ANALYSIS People and Context Research and Design Insights and Strategy
3.	CONCEPTING and BUILDING Conceptualize Designs, Create a Concept, Storyboarding and Rapid Prototyping
4.	TESTING, REFINING and PITCHING Usability Testing, Refine and Enhance Design and Define pitch



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**Humanities
and Social
Sciences**

Pre-requisites:

Bachelors Degree in Engineering, Technology, Business, Architecture, Humanities

Coordinators:

Prof. Jhumkee Iyengar
Design Program IIT Kanpur



WELDING METALLURGY

PROF. PRADEEP K. JHA

Department of Metallurgy and Material Science
IIT Roorkee

TYPE OF COURSE : Rerun | Core | PG/UG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 24 Apr 2022

PRE-REQUISITES : Introduction to courses such as Welding processes, Materials science etc.

INDUSTRIES APPLICABLE TO : Manufacturing Industries like SAIL, BHEL etc.

COURSE OUTLINE :

The course focuses on understanding the metallurgy and solidification of weldments. The course will make the students aware with the metallurgical aspects of welding. For getting a sound weld, the students are required to be aware of the science behind the welding phenomena, especially in the domain of weld metal solidification, heat transfer, heat treatment processes, strengthening mechanisms etc. The course will be useful for engineering graduates as well as professionals working in the area of welding.

ABOUT INSTRUCTOR :

Prof. Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & Industrial Engineering at IIT Roorkee. He has been teaching the courses related to manufacturing technology and theory of production processes to undergraduate and postgraduate students for more than 12 years. He is actively involved in research work related to production processes, especially casting and welding processes.

COURSE PLAN :

Week 1: Introduction to welding metallurgy, phase diagrams

Week 2: Phase transformation, TTT and CCT diagrams

Week 3: Metal strengthening approaches

Week 4: Heat treatment processes for weldments

Week 5: Analysis of heat flow and temperature distribution in welding

Week 6: Concept of solidification in welding, constitutional supercooling

Week 7: Introduction to heat affected zones, Properties of HAZ

Week 8: Residual stresses in welding, Preheat and postweld heat treatment

Week 9: Types of welding distortion and its control

Week 10: Cracks in welds

Week 11: Weldability issues in materials

Week 12: Welding defects, Design considerations in welding



WELDING OF ADVANCED HIGH STRENGTH STEELS FOR AUTOMOTIVE APPLICATIONS

PROF. MURUGAIYAN AMIRTHALINGAM

Department of Metallurgical and Materials Engineering
IIT Madras

INTENDED AUDIENCE : Final year bachelors and masters students in Metallurgy, Mechanical, Automobile and Production Engineering. Industrial personnel working in automotive and steel making industries.

PRE-REQUISITES : Final year B.E/B.Tech students or Graduates of Metallurgical/Mechanical/Automobile/Production Engineering, Basic knowledge of steel physical metallurgy and welding processes.

INDUSTRIES APPLICABLE TO : All automotive manufacturers and their OEMs and Steel plants.

COURSE OUTLINE :

The use of advanced high strength steels (AHSS) is increasingly preferred in automotive applications due to improved crash energy management and enhanced strength-ductility combinations, resulting in greener and safer vehicles. The weldability of AHSS is generally poorer than conventional steels due to the high alloying contents required to obtain multi-phase microstructure. This course is aimed to discuss the (i) role of alloying elements in stabilizing multi-phase microstructures of AHSS, (ii) effect of weld thermal cycles on the evolution of microstructures and (iii) weldability of AHSS.

ABOUT INSTRUCTOR :

Prof. Murugaiyan Amirthalingam is currently working as an Assistant Professor in IIT-Madras. His research interests include welding metallurgy, welding processes development, steel product development and additive manufacturing

COURSE PLAN :

Week 01 : Introduction to physical metallurgy of advanced high strength steels

Week 02 : Introduction to welding processes in automotive industries (Advanced Gas Metal Arc, Resistance Spot and Laser Welding Processes).

Week 03 : Welding metallurgy of advanced high strength steels – Effect of weld thermal cycles on the stability of phases, solidification behaviour, segregation and hot cracking susceptibility.

Week 04 : Mechanical properties of advanced high strength steel weldments – Tensile shear testing, HAZ softening characteristics, role of modified weld thermal cycles (post pulsing and post weld heat treatments) to improve the mechanical properties.



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Dr. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed eight video and one web course under the National Programme on Technology Enhanced Learning (NPTEL, MOOCs). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

Course certificate

- The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
- The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
- **Date and Time of Exams: 29 September 2019**, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
- Registration url: Announcements will be made when the registration form is open for registrations.
- The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
- Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

- Average assignment score = 25% of average of best 3 assignments out of the total 4 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100.
- Final score = Average assignment score + Exam score.



ADVANCED COMPUTER ARCHITECTURE

PROF. JOHN JOSE

Department of Computer Science and Engineering
IIT Guwahati

TYPE OF COURSE : Rerun | Elective | PG

COURSE DURATION : 8 weeks (21 Feb'22 - 15 Apr'22)

EXAM DATE : 24 Apr 2022

PRE-REQUISITES : A basic understanding of Computer Organisation & Architecture or Microprocessors

INTENDED AUDIENCE : Anyone in CSE and related fields (like ECE, EEE, IT etc.) with an interest of exploring Computer Architecture

INDUSTRIES APPLICABLE TO : Intel, AMD, IBM, Nvidia etc

COURSE OUTLINE :

Applications and handheld devices play a major role in ensuring comfort in our day- today life. These applications run on handheld electronic gadgets with high-end microprocessor support. Modern CPU designers handle challenges imposed by these applications with cost effective architectural enhancements. This course provides a deeper insight into the design of high-end microprocessors that will support the future applications.

ABOUT INSTRUCTOR :

Prof. John Jose is an Assistant Professor in Department of Computer Science and Engineering, Indian Institute of Technology, Guwahati. Prior to this he worked as faculty in Rajagiri School of Engineering and Technology and Viswajyothi College of Engineering and Technology, Kerala for 7 years. He completed his Ph.D degree in Department of Computer Science and Engineering, Indian Institute of Technology, Madras. He has guided over 8 M.Tech thesis and is currently supervising 6 PhD thesis and 2 M.Tech thesis. His area of interest is in on-chip interconnection networks and cache management techniques for large multicore systems. He is the principal investigator of two sponsored R&D projects funded by DST, Govt of India. He is having active research collaboration with University of Catania-Italy, ITRI Taiwan, and BITS Pilani-Dubai Campus.

COURSE PLAN :

Week 1: Review of Basic Computer Organization, Performance Evaluation Methods, Introduction to RISC Instruction Pipeline, Instruction Pipeline and Performance.

Week 2: Pipeline Hazards and Analysis, Branch Prediction, MIPS Pipeline for Multi-Cycle Operations.

Week 3: Compiler Techniques to Explore Instruction Level Parallelism, Dynamic Scheduling with Tomasulo's Algorithm and Speculative Execution.

Week 4: Advanced Pipelining and Superscalar Processors, Exploiting Data Level Parallelism: Vector and GPU Architectures, Architectural Simulation using gem5.

Week 5: Introduction to Cache Memory, Block Replacement Techniques and Write Strategy, Design Concepts in Cache Memory.

Week 6: Basic and Advanced Optimization Techniques in Cache Memory, Cache Optimization using gem5.

Week 7: Introduction to DRAM System, DRAM Controllers and Address Mapping, Secondary Storage Systems, Design Concepts in DRAM and Hard Disk.

Week 8: Tiled Chip Multicore Processors(TCMP), Routing Techniques in Network on Chip(NoC), NoC Router Microarchitecture, TCMP and NoC: Design and Analysis, Future Trends in Computer Architecture Research.



ADVANCED MACHINING PROCESSES

PROF. MANAS DAS

Department of Mechanical Engineering
IITGuwahati

INTENDED AUDIENCE : Intended for UG and PG students who plan to take up this subject as their future research area. Also, for practitioner in industries who want to implement new development technologies in advanced machining to their factory.

INDUSTRIES APPLICABLE TO : Bharat Heavy Electricals Limited (BHEL), Hindustan Aeronautics Limited (HAL), Defense Research and Development Organization (DRDO), Die manufacturing industries, Automobile Industries, Machine Tool Industries, Precision medical equipment manufacturing industries, High precision optics and semiconductor industries

COURSE OUTLINE :

There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and workpieces with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called unconventional in the sense that conventional tools are not employed for metal cutting. Instead, energy in its direct form is used to remove the material from the workpiece. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of unconventional / nontraditional / modern machining processes.

ABOUT INSTRUCTOR :

Prof. Manas Das is an Assistant Professor in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati, India since 2012. He received his Masters and Ph.D. degree from Mechanical engineering Department, IIT Kanpur. His research areas include Advanced Finishing and Nano-finishing Processes, Magnetorheological Finishing (MRF) Process, Advanced/Non-traditional Machining Processes, Micromachining processes. Dr. Das has published more than 20 papers in reputed journal and conferences. He has also written 2 book chapters in the area of surface finishing. Presently, he is supervising 5 Ph.D. students in the broad area of manufacturing.

COURSE PLAN :

Week 1 : Introduction to advanced machining processes and their classification
Ultrasonic machining and its modelling and analysis

Week 2 : Abrasive jet machining (AJM)

Water jet cutting (WJC) and Abrasive water jet machining (AWJM)
Magnetic abrasive finishing (MAF) and its modelling

Week 3 : Abrasive flow finishing (AFF) and its modelling
Magnetorheological finishing (MRF)

Week 4 : Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis

Week 5 : Electric discharge machining (EDM): Principle, applications, process parameters, and modelling

Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM)

Week 6 : Laser beam machining (LBM)

Plasma arc machining (PAM)

Electron Beam Machining (EBM)

Week 7 : Electro chemical machining (ECM): Principle, applications, and process parameters and modelling

Week 8 : Electrochemical Grinding (ECG), Electrostream Drilling (ESD), Shaped Tube Electrolytic Machining (STEM), Chemical machining (ChM)



AN INTRODUCTION TO ARTIFICIAL INTELLIGENCE

PROF. MAUSAM

Department of Computer Science and Engineering
IIT Delhi

PRE-REQUISITES : Data Structures, Probability

INTENDED AUDIENCE : Undergraduate students in computer science

INDUSTRIES APPLICABLE TO : Most software companies

COURSE OUTLINE :

The course introduces a variety of concepts in the field of artificial intelligence. It discusses the philosophy of AI, and how to model a new problem as an AI problem. It describes a variety of models such as search, logic, Bayes nets, and MDPs, which can be used to model a new problem. It also teaches many first algorithms to solve each formulation. The course prepares a student to take a variety of focused, advanced courses in various subfields of AI.

ABOUT INSTRUCTOR :

Prof. Mausam is an Associate Professor of Computer Science department at IIT Delhi, and an affiliate faculty member at University of Washington, Seattle. His research explores several threads in artificial intelligence, including scaling probabilistic planning algorithms, large-scale information extraction over the Web, and enabling complex computation over crowdsourced platforms. He received his PhD from University of Washington in 2007 and a B.Tech. from IIT Delhi in 2001. ArnetMiner, a global citation aggregator, has rated Mausam as the 25th most influential scholar in AI for 2019. He was recently awarded the AAAI Senior Member status for his long-term participation in AAAI and distinction in the field of artificial intelligence.

COURSE PLAN :

Week 1: Introduction: Philosophy of AI, Definitions

Week 2: Modeling a Problem as Search Problem, Uninformed Search

Week 3: Heuristic Search, Domain Relaxations

Week 4: Local Search, Genetic Algorithms

Week 5: Adversarial Search

Week 6: Constraint Satisfaction

Week 7: Propositional Logic & Satisfiability

Week 8: Uncertainty in AI, Bayesian Networks

Week 9: Bayesian Networks Learning & Inference, Decision Theory

Week 10: Markov Decision Processes

Week 11: Reinforcement Learning

Week 12: Introduction to Deep Learning & Deep RL



AN INTRODUCTION TO PROGRAMMING THROUGH C++

PROF. ABHIRAM G. RANADE

Department of Computer Science
IIT Bombay

TYPE OF COURSE : Rerun | Core | UG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 24 Apr 2022

PRE-REQUISITES : Standard XII in the Science stream.

INTENDED AUDIENCE : First and second year students in degree programs including Engineering and Science degree programs.

INDUSTRIES APPLICABLE TO : Basic programming is of value to all. C++ allows you to design very fast programs and access low level machine features, but at the same time its libraries provide a very high level programming model. It can be considered a modern, safer version of the C language.

COURSE OUTLINE :

This course provides an introduction to problem solving and programming using the C++ programming language. The topics include: Basic programming notions. Control flow, variables and assignments state-ments, conditional execution, looping, function calls including recursion. Arrays and structures. Elementary aspects of classes. Heap memory. Program design. How human beings solve problems manually. Strategies for translating manual strategies to computer programs. Organizing large programs into units such as functions and classes. Introduction to assertions and invariant. Programming applications. Arithmetic on polynomials, matrices. Root finding. Sorting and searching. Design of editors and simulators, including graphical editors. Elementary animation. A rudimentary graphics system will be discussed. Standard Library of C++. The string, vector and map classes.

ABOUT INSTRUCTOR :

Prof. Abhiram G. Ranade is a Professor of Computer Science and Engineering at IIT Bombay. He obtained a B. Tech. degree in Electrical Engineering from IIT Bombay in 1981. In 1988 he obtained a Ph.D. in Computer Science from Yale University, USA. He was an Assistant Professor of Electrical Engineering and Computer Science at the University of California, Berkeley, USA during 1988-94. Since 1995 he has been a faculty member in IIT Bombay. His research interests are Algorithms, Combinatorial Optimization, Scheduling in Transportation Systems, and Programming Education. He has won Excellence in Teaching Awards of IIT Bombay in 2006-7 and 2010-11.

COURSE PLAN :

Week 1: Introduction to computers using graphics. Notions of program organization, control flow.

Week 2: Basic data types. Variables. Assignment statement. Introduction to program design using examples such as summing infinite series.

Week 3: Statements of C++ for conditional execution and looping.

Week 4: Applications such as computing mathematical functions, root finding.

Week 5: Functions. Parameter passing. Recursion. Correctness issues.

Week 6: Recursive algorithms and recursive drawings. Breaking larger programs into functions.

Week 7: Arrays. Basic array processing strategies including passing arrays to functions. Pointers. Applications illustrating use of arrays to store sets and sequences. Iterating over pairs of objects from an array, Selection sort.

Week 8: Use of arrays to represent textual data. Multidimensional arrays. Command line arguments. Binary search. Merge sort.

Week 9: Structures. Pointers with structures. Structure examples.

Week 10: Dynamic memory allocation. Basic mechanisms and pitfalls.

Week 11: Use of the standard library in designing programs. Design of medium size programs.

Week 12: A program for designing and solving resistive circuits with a graphical user interface.



APPLIED ERGONOMICS

PROF. SHANTANU BHATTACHARYA

Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun | Elective | UG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 23 Apr 2022

PROF. ANKUR GUPTA

Department of Mechanical Engineering
IIT Jodhpur

INTENDED AUDIENCE : Students of B.Tech/M.Tech/MS/BSc/MSc stream

INDUSTRIES APPLICABLE TO : Industries related to Work Study and Management

PRE REQUISITES : Nil

COURSE OUTLINE :

"Ergonomics" is an applied scientific discipline that is concerned with how humans interact with the system/equipment/surrounding while performing tasks and other activities. Syllabus includes Introduction, Physical, Cognitive, Occupational and biomechanics aspect. The course syllabus is designed so as to cover work physiology, Engineering aspect of product, improvement in the cognitive capabilities and other relevant topics. Students will be able to correlate the understanding of this subject with their day to day activities and will be aware of concepts related to increase in the human and system efficiency.

ABOUT INSTRUCTOR :

Prof. Shantanu Bhattacharya is currently a Professor at the Department of Mechanical Engineering at the Indian Institute of Technology Kanpur. Prior to joining IIT Kanpur he was associated with Suzuki Motors in the senior management level and has over 6 years of experience in various production capacities and positions.

Prof. Ankur Gupta is currently working as an Assistant Professor in the Department of Mechanical Engineering at Indian Institute of Technology, Jodhpur. He did his PhD from IIT Kanpur and served IIT Bhubaneswar as a faculty before joining, IIT Jodhpur.

COURSE PLAN :

Week 1: Introduction and Overview of Ergonomics

Week 2: Human centred design

Week 3: Anthropometry

Week 4: Physical Ergonomics-I

Week 5: Physical Ergonomics-II

Week 6: Tools and techniques for Ergonomics

Week 7: Cognitive Ergonomics-I

Week 8: Cognitive Ergonomics-II

Week 9: Cognitive Ergonomics-III

Week 10: Physical Environment and its importance

Week 11: Biomechanics

Week 12: Occupational Ergonomics and use of Ergonomics



BIG DATA COMPUTING

PROF. RAJIV MISRA

Department of Computer science and engineering
IIT Patna

PRE-REQUISITES : Data Structure & Algorithms, Computer Architecture, OperatingSystem, Database Management Systems

INDUSTRY SUPPORT : Companies like Amazon, Microsoft, Google, IBM, Facebook

COURSE OUTLINE :

In today's fast-paced digital world , the incredible amount of data being generated every minute has grown tremendously from sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction records, and GPS signals from cell phone to name a few. This amount of large data with different velocities and varieties is termed as big data and its analytics enables professionals to convert extensive data through statistical and quantitative analysis into powerful insights that can drive efficient decisions. This course provides an in-depth understanding of terminologies and the core concepts behind big data problems, applications, systems and the techniques, that underlie today's big data computing technologies. It provides an introduction to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce, Large scale data storage technologies such as in-memory key/value storage systems, NoSQL distributed databases, Apache Cassandra, HBase and Big Data Streaming Platforms such as Apache Spark Streaming, Apache Kafka Streams that has made big data analysis easier and more accessible. And while discussing the concepts and techniques, we will also look at various applications of Big Data Analytics using Machine Learning, Deep Learning, Graph Processing and many others. The course is suitable for all UG/ PG students and practicing engineers/ scientists from the diverse fields and interested in learning about the novel cutting edge techniques and applications of Big Data Computing.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is working in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelor's of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile, Adhoc and Sensor Networks, Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 70 papers in high quality journals and conferences, and 2 book chapters. His h-index is 10 with more than 590 citations. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, IEEE Systems Journal, Adhoc Networks, Computer Network, Journal of Parallel and Distributed Computing. He has edited a book titled as "Smart Techniques for a Smarter Planet: Towards Smarter Algorithms" for the "Studies in Fuzziness and Soft Computing" book series, Springer (2018). He has supervised four Phd students and currently four Phd students working under his supervision in the area of big data, cloud computing, distributed computing, and sensor networks. He is a senior member of the IEEE and fellow of IETE. He has completed as the Principal Investigator of R&D Project Sponsored by DeITY entitled as "Vehicular Sensor and Mesh Networks based Future ITS". He has mentored the online courses on Cloud Computing, Advanced Graph Theory and Distributed Systems in the platform of NPTEL

COURSE PLAN :

Week 1: Introduction to Big Data

Week 2: Introduction to Enabling Technologies for Big Data

Week 3: Introduction to Big Data Platforms

Week 4: Introduction to Big Data Storage Platforms for Large Scale Data Storage

Week 5: Introduction to Big Data Streaming Platforms for Fast Data

Week 6: Introduction to Big Data Applications (Machine Learning)

Week 7: Introduction of Big data Machine learning with Spark

Week 8: Introduction to Big Data Applications (Graph Processing)



BLOCKCHAIN AND ITS APPLICATIONS

PROF. SANDIP CHAKRABORTY

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SHAMIK SURAL

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Computer Networks; Operating Systems; Cryptography and Network Security

INTENDED AUDIENCE : Undergraduate Students, Postgraduate Students, Industry Associates

INDUSTRIES APPLICABLE TO : IBM; HPE; Intel; Any startups working on Blockchain

COURSE OUTLINE :

In the last few years, Blockchain technology has generated massive interest among governments, enterprises, and academics, because of its capability of providing a transparent, secured, tamper-proof solution for interconnecting different stakeholders in a trustless setup. In January 2021, the Ministry of Electronics and Information Technology (MeiTY), Government of India, published the first draft of the "National Strategy on Blockchain" that highlights 17 potential applications that are of national interest. Against this backdrop, this subject will cover the basic design principles of Blockchain technology and its applications over different sectors. Additionally, the course also provides tutorials on setting up blockchain applications using one of the well-adopted permissionless blockchain platforms -Ethereum, and one permissioned blockchain platform - Hyperledger.

ABOUT INSTRUCTOR :

Prof. Sandip Chakraborty is working as an Associate Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology (IIT) Kharagpur. He obtained his Bachelor of Engineering (BE) degree from Jadavpur University, Kolkata in 2009 and Master of Technology (M Tech) and Doctor of Philosophy (Ph.D.), both from IIT Guwahati, in 2011 and 2014, respectively. The primary research interests of Dr. Chakraborty is in the intersection of Computer Systems, Pervasive Computing, and Human-Computer Interaction. Dr. Chakraborty is leading the System and Mobile Research Lab at IIT Kharagpur, focusing on various aspects of computer systems and networks along with the design and development of ubiquitous and pervasive sensing systems. He is one of the founding members of ACM IMOBILE, the ACM SIGMOBILE chapter in India. He is working as an Area Editor of Elsevier Ad Hoc Networks and Elsevier Pervasive and Mobile Computing journal. He has received various awards and accolades including Excellent Young Teacher Award 2021, INAE Young Engineers' Award, Fellow of National Internet Exchange of India (NIXI), and so on. Further details about his works and publications can be obtained from <https://cse.iitkgp.ac.in/~sandipc/index.html>.

Prof. Shamik Sural is a full professor in the Department of Computer Science and Engineering, Indian Institute of Technology (IIT) Kharagpur. He received the Ph.D. degree from Jadavpur University, Kolkata, India in the year 2000. Before joining IIT Kharagpur in 2002, he spent more than a decade in the Information Technology industry working in India as well as in Michigan, USA. Prof. Sural was a recipient of the Alexander van Humboldt Fellowship for Experienced Researchers in 2009, which enabled him to carry out collaborative research at the Technical University of Munich, Germany. Later in 2018, he was awarded a Humboldt Foundation Alumni Fellowship for a renewed research stay in Germany. He also spent the Fall 2019 semester at Rutgers University, USA as a Fulbright scholar engaged in both teaching and research. During this period, he visited several other universities in the USA for delivering invited lectures. Prof. Sural is a senior member of IEEE and has previously served as the Chairman of the IEEE Kharagpur Section in 2006. He is currently on the editorial boards of IEEE Transactions on Dependable & Secure Computing, IEEE Transactions on Services Computing and Sadhana – a journal of the Indian Academy of Sciences. He has published more than two hundred research papers in reputed international journals and conferences. His research interests include computer security, data mining and multimedia systems.

COURSE PLAN :

Week 1: Introduction to Blockchain Technology and its Importance

Week 2: Basic Crypto Primitives I - Cryptographic Hash

Week 3: Basic Crypto Primitives II - Digital Signature

Week 4: Evolution of the Blockchain Technology

Week 5: Elements of a Blockchain

Week 6: Blockchain Consensus I - Permissionless Models

Week 7: Blockchain Consensus II - Permissioned Models

Week 8: Smart Contract Hands On I - Ethereum Smart Contracts (Permissionless Model) **Week 9:** Smart Contract
Hand On II - Hyperledger Fabric (Permissioned Model)

Week 10: Decentralized Identity Management

Week 11: Blockchain Interoperability

Week 12: Blockchain Applications



Cloud Computing

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE,ECE,EE

PREREQUISITES : Basics of Computer Architecture and Organization, Networking

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE:

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

ABOUT THE INSTRUCTOR:

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN:

- Week 1:** Introduction to Cloud Computing
- Week 2:** Cloud Computing Architecture
- Week 3:** Service Management in Cloud Computing
- Week 4:** Data Management in Cloud Computing
- Week 5:** Resource Management in Cloud
- Week 6:** Cloud Security
- Week 7:** Open Source and Commercial Clouds, Cloud Simulator
- Week 8:** Research trend in Cloud Computing, Fog Computing
- Week 9:** VM Resource Allocation, Management and Monitoring
- Week 10:** Cloud-Fog-Edge enabled Analytics
- Week 11:** Serverless Computing and FaaS Model
- Week 12:** Case Studies and Recent Advancements

COMPUTER GRAPHICS

COURSE LAYOUT

Week 1 : Introduction – historical evolution, issues and challenges, graphics pipeline, hardware and software basics

Week 2 : Object representation – boundary representation, splines, space partitioning

Week 3 : Modeling transformations – matrix representation, homogeneous coordinate system, composition, 3D transformations

Week 4 : Illumination and shading – background, simple lighting model, shading models, intensity representation, color models, texture synthesis

Week 5 : 3D viewing – viewing pipeline, view coordinate system, viewing transformation, projection, window-viewport transformation

Week 6 : Clipping and hidden surface removal – clipping in 2D. 3D clipping algorithms, hidden surface removal

Week 7 : Rendering – scan conversion of line, circle, fill-area and characters, anti-aliasing

Week 8 : Graphics hardware and software – generic architecture, I/O, GPU, Shader programming, graphics software (openGL)



COMPUTER INTEGRATED MANUFACTURING

PROF. JANAKARAJAN RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Use of computers in manufacturing in order to design and develop the products has found unprecedented applications. Computer integrated way of manufacturing provides a myriad of benefits such as speed, flexibility, and better control. In this course, Computer Integrated Manufacturing (CIM) approaches are discussed. CAD/CAM tools and their within and between the production systems are presented along with appropriate case studies. Data storage and handling is also the need of contemporary manufacturing systems. This is also catered using software tools. The course is reinforced with the laboratory demonstrations to add a practitioners' touch. Students would develop a prowess to largely plan, design and develop a product and a production system after completing this course

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers

Prof. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1: Introduction to Computer Integrated Manufacturing (CIM)

Week 2: Computer Aided Design

Week 3: Computer Aided Manufacturing

Week 4: Computer Numerical Control

Week 5: Computer Aided Process Planning (CAPP)

Week 6: CIM interfaces: CAD vs CAM

Week 7: Data and information in CIM

Week 8: Manufacturing Systems and their design

Week 9: Simulation of Manufacturing Systems

Week 10: Computer Aided Maintenance

Week 11: Computer Integrated Additive Manufacturing

Week 12: Advanced CIM techniques



COMPUTER NETWORKS AND INTERNET PROTOCOL

PROF. SOUMYA KANTI GHOSH

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SANDIP CHAKRABORTY

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE, ECE, EE students

INDUSTRIES APPLICABLE TO : IT industries

COURSE OUTLINE :

The domain of Internet has grown in a rapid pace from traditional circuit switched and packet switched small scale networks to modern high-speed mobile and wireless Internet. A large number of methods, architectures and designs came up at every protocol level to cope up with the demands for developing a secure and highly dependable information technology infrastructure. The broad objective of the course is to understand - (i) the architecture and principles of today's computer networks, (ii) the protocols and their functionalities, (iii) the requirements for the future Internet and its impact on the computer network architecture. In this course, we'll broadly cover the basic TCP/IP protocol stack and touch on the next generation computer networks. We'll take a top-down approach to cover different protocols at the TCP/IP protocol stack.

ABOUT INSTRUCTOR :

Prof. Soumya K. Ghosh received Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT, Kharagpur. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

Prof. Sandip Chakraborty received Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT, Guwahati. Presently, he is an Assistant Professor with Department of Computer Science and Engineering, IIT Kharagpur. He has around 100 research papers in reputed journals and conference proceedings. His research interests include computer systems, distributed systems and mobile computing.

COURSE PLAN :

- Week 1 :** Introduction to Computer Networks History, Circuit Switching and Packet Switching
- Week 2 :** TCP/IP Protocol Stack – Basic Overview
- Week 3 :** Application Layer Services (HTTP, FTP, Email, DNS)
- Week 4 :** Transport Layer Primitives – Connection Establishment and Closure
- Week 5 :** Flow Control and Congestion Control at the Transport Layer
- Week 6 :** Transmission Control Protocol – Basic Features, TCP Congestion Control
- Week 7 :** Network Layer Primitives – IP Addressing
- Week 8 :** IP Routing – Intra Domain Routing Protocols, Inter Domain Routing Protocols (BGP)
- Week 9 :** IP Services – SNMP, ARP
- Week 10 :** Data Link Layer Service Primitives – Forwarding, Flow Control, Error Control
- Week 11 :** Media Access Control - Channel Access Protocols, Framing
- Week 12 :** End to End Principles of Computer Networks

Consumer Behaviour - Video course

COURSE OUTLINE

Focus of the course would be on the psychological and sociological elements and their impact on consumer decision making. The course will help the students take a holistic view of the buyer; it will help equip them with knowledge of various models and frameworks to help understand buyer behavior and align the knowledge with formulation of appropriate marketing strategies. The objective is to gain an understanding of the theoretical and conceptual concepts of buyer behavior and apply them to real life marketing situations and practices.

COURSE DETAIL

S.No	Topic	No. of Hours
1	Module 1: Introduction To The Study of Consumer Behavior	2
2	Module 2: Market Research and Consumer Behavior	2
3	Module 3: Market Segmentation and Positioning	2
4	Module 4: The Consumer Decision Making Process	2
5	Module 5: Models Of Consumers	4
6	Module 6: Psychological Influences on Consumer Decision Making	19
7	Module 7: Sociological Influences on Consumer Decision Making	7
8	Module 8: Diffusion of Innovation	2
	Total Hours	40

References:

- Consumer Behavior, Schiffman, L.G. and Kanuk L.L., Prentice Hall, India
- Consumer Behavior, Concepts and Applications, Loudon, D.L. and Bitta, A.J.D, Tata McGraw Hill
- Consumer Behavior and Marketing Strategy, Peter, J.P. and Olson, J.C., Schiffman, L.G. and Kanuk L.L., Prentice Hall, India

NPTEL

<http://nptel.iitm.ac.in>

Management

Pre-requisites:

Marketing Management.

Coordinators:

Dr. Sangeeta Sahney
Vinod Gupta School of
Management IIT
Kharagpur



CONSUMER PSYCHOLOGY

PROF. NAVEEN KASHYAP

Department of Humanities and Social Sciences
IIT Guwahati

INTENDED AUDIENCE : UG / PG / PhD

COURSE OUTLINE :

Human beings have basic needs that they fulfill by making transactions in the market. Transactions mostly in the form of monetary exchange for goods and services are very basic for the survival of the human race. The present course is designed to study how consumers behave on the market and what the consequences of various behavior patterns. Additionally, the present course also looks at various psychological factors that shape the behavior and actions of the consumer in the global market.

ABOUT INSTRUCTOR :

Prof. Naveen Kashyap, Ph.D is an Associate Professor of Psychology at the Indian Institute of Technology Guwahati. His research interests are sleep and human cognitive processes. Dr Kashyap has been teaching courses like cognitive psychology, introduction to psychology, consumer psychology, advanced cognitive process and research methodology to UG and PG students of IITG for the past 10 years.

COURSE PLAN :

Week 1: Introduction to Consumer Psychology

Week 2: Overview of foundation of consumer behavior.

Week 3 : Consumer Decision Making

Week 4 : Purchase process and consumption; Consumer learning and brand loyalty

Week 5 : Low involvement decision making; Situational influences.

Week 6 : The Individual Consumer; Consumer perceptions; Consumer information processing and acquisition

Week 7 : Attitudes; Attitude reinforcement and change

Week 8 : Marketing Communications.



CYBER SECURITY AND PRIVACY

PROF. SAJI K MATHEW

Department of Management Studies
IIT Madras

PRE-REQUISITES : A core course on Management Information Systems desirable (not mandatory)

INDUSTRY SUPPORT : IT services industry, AI/Block chain start ups, Industry 4.0, autonomous vehicles industry

COURSE OUTLINE :

This course introduces to management students the concepts, technologies, practices and challenges associated with cybersecurity as applied in organizations. Protection as well as disclosure of information pose unique challenges and also allude to economic and technological implications. The course takes a broad view of cyber security along with information privacy by analysing relevant organizational, human, legal and policy issues. Through this course, students will explore cyber security along with information privacy with a managerial focus. Students are expected to develop a wholesome understanding about cyber security and privacy risks to businesses covering governance, compliance and risk mitigation and closely study certain business domains.

ABOUT INSTRUCTOR :

Prof.Saji K Mathew is currently a Professor at the Department of Management Studies, Indian Institute of Technology Madras, India. As a Fulbright Scholar, he did his post-doctoral research on offshore IT outsourcing at the Goizueta Business School of Emory University, Atlanta (USA). His current research focuses on behavioral cyber security, information privacy, misinformation and digital nudging. He has published research in leading IS journals while also making editorial contributions to some of them. He is a founding member of the Association for Information Systems India Chapter (INAIS) and presently serves as its Vice President.

COURSE PLAN :

Week 1 : Introduction - Introduction to cyber security, Confidentiality, integrity, and availability.

Week 2 : Foundations - Fundamental concepts, CIA, CIA triangle, data breach at target.

Week 3 : Security management, Governance, risk, and compliance (GRC)- GRC framework, security standards.

Week 4 : Control strategies and protection mechanisms (Guest lecture), Cryptography for security.

Week 5 : Cyber security policy - ESSP, ISSP, SYSSP.

Week 6 : Risk Management - Cyber Risk Identification, Assessment, and Control.

Week 7 : Cyber security: Industry perspective - Defense Technologies, Attack, Exploits.

Week 8 : Cyber security technologies - Access control, Encryption, Standards.

Week 9 : Foundations of privacy - Information privacy, Measurement, Theories.

Week 10 : Privacy regulation - Privacy, Anonymity, Regulation, Data Breach.

Week 11 : Privacy regulation in Europe, Privacy: The Indian Way - Data Protection, GDPR, DPDP, Aadhar.

Week 12 : Information privacy: Economics and strategy, Economic value of privacy, privacy valuation, WTA and WTC, Business strategy and privacy, espionage, Privacy vs safety.



DATA ANALYSIS AND DECISION MAKING - I

PROF. RAGHU NANDAN SENGUPTA

Department of Management
IIT Kanpur

PRE-REQUISITES : Probability & Statistics, Operations Research

INTENDED AUDIENCE : Masters in Business Administration, Masters in Economics, Masters in Statistics/Mathematics, Masters in Industrial Engineering, Masters in Operations Research/Operations Management, Phd in related fields as mentioned above

INDUSTRIES APPLICABLE TO : Manufacturing industry, chemical industry, steel industry, cement industry, etc.

COURSE OUTLINE :

This is the first part of the three part course (DADM-I, DADM-II, DADM-III) which covers Operations Research and its tools with applications. In general Decision Analysis and Decision Making (DADM) covers three main areas which are: Multivariate Statistical Analysis with its applications, Other Decision Making Models like DEA, AHP, ANP, TOPSIS, etc., and Operations Research and its tools with applications. These three part DADM course will be more practical and application oriented rather than theoretical in nature.

ABOUT INSTRUCTOR :

Prof. Raghu Nandan Sengupta completed his bachelors in engineering in Mechanical Engineering from Birla Institute of Technology Mesra, Ranchi INDIA and his FPM (PhD) from Indian Institute of Management Calcutta, INDIA with specialization in Operations Management. His research interests are in Sequential Analysis, Statistical & Mathematical Reliability, Optimization and its use in Financial Optimization. His research work has been published in journals like Metrika, European Journal of Operational Research, Sequential Analysis, Computational Statistics & Data Analysis, Communications in Statistics: Simulation & Computation, Quantitative Finance, etc. At Indian Institute of Technology Kanpur, INDIA he is a Professor in the Industrial & Management Engineering department and teaches courses like Probability & Statistics, Stochastic Processes & their Applications, Management Decision Analysis, Financial Risk Management, etc. He is also the recipient of IUSSTF Fellowship 2008 and visited Operations Research & Financial Engineering department at Princeton University, USA, ERASMUS MUNDUS Fellowship 2011 to Warsaw University, POLAND, EU-NAMASTE Fellowship 2015 to IST, University of Lisboa, PORTUGAL, DAAD Fellowship 2015 to TU Dresden, GERMANY.

COURSE PLAN :

Week 1: Introduction to Multivariate Analysis

Week 2: Joint and marginal Distribution

Week 3: Multinomial, Multivariate Normal, Multivariate t, Wishart and other Distributions

Week 4: Multivariate Extreme Valued Distributions

Week 5: Copula Method

Week 6: Multiple Linear Regression, Multiple Non-Linear Regression, etc.

Week 7: Factor Analysis

Week 8: MANOVA, MANCOVA, etc.

Week 9: Conjoint Analysis

Week 10: Cluster Analysis

Week 11: Multiple Discriminant Analysis

Week 12: Multidimensional Scaling, Structural Equation Modeling



DATA ANALYTICS WITH PYTHON

PROF. A RAMESH

Department of Management Studies
IIT Roorkee

INTENDED AUDIENCE : Management, Industrial Engineering and Computer Science Engineering Students

INDUSTRIES APPLICABLE TO : Any analytics company

COURSE OUTLINE :

We are looking forward to sharing many exciting stories and examples of analytics with all of you using python programming language. This course includes examples of analytics in a wide variety of industries, and we hope that students will learn how you can use analytics in their career and life. One of the most important aspects of this course is that you, the student, are getting hands-on experience creating analytics models; we, the course team, urge you to participate in the discussion forums and to use all the tools available to you while you are in the course!

ABOUT INSTRUCTOR :

Prof. Ramesh Anbanandam graduated in Production Engineering from Madras University, Chennai. He did his post-graduation from National Institute of Technology, Trichy. He later earned his Ph.D. in Supply Chain Management from Indian Institute of Technology Delhi. His professional interest includes Humanitarian Supply Chain Management, Operations Management, Operations Research, Healthcare Waste Management, Sustainable Multi-model and Freight Transportation, Transportation Asset Management and Advanced Data Analytics using Python and R-programming. He has published various research articles in reputed journals. He was also awarded Emerald Literati Award for Excellence under "Highly Commended Research Paper in the Year 2011 and 2016" in the field of Supply Chain Management.

COURSE PLAN :

Week 1: Introduction to data analytics and Python fundamentals

Week 2: Introduction to probability

Week 3: Sampling and sampling distributions

Week 4: Hypothesis testing

Week 5: Two sample testing and introduction to ANOVA

Week 6: Two way ANOVA and linear regression

Week 7: Linear regression and multiple regression

Week 8: Concepts of MLE and Logistic regression

Week 9: ROC and Regression Analysis Model Building

Week 10: χ^2 Test and introduction to cluster analysis

Week 11: Clustering analysis

Week 12: Classification and Regression Trees (CART)



DATA BASE MANAGEMENT SYSTEM

PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SAMIRAN CHATTOPADHYAY

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Procedural and / or Object-Oriented Programming (C / C++ / Java / Python), Data Structures, Algorithms

INTENDED AUDIENCE : Students from all disciplines can enroll for this course.

INDUSTRIES APPLICABLE TO : DBMS is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems, data mining, machine learning) have a need for the same. These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

COURSE OUTLINE :

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. Consequently, Oracle, Microsoft SQL Server, Sybase etc. have emerged as leading commercial systems while MySQL, PostgreSQL etc. lead in open source and free domain.

While DBMS's differ in the details, they share a common set of models, design paradigms and a Structured Query Language (SQL). In this background the course examines data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation. More specifically, the course introduces relational data models; entity-relationship modeling, SQL, data normalization, and database design. Further it introduces query coding practices using MySQL (or any other open system) through various assignments. Design of simple multi-tier client / server architectures based and Web-based database applications is also introduced.

ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Prof. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (<https://www.facebook.com/t10kt.algorithms/>) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

Prof. Samiran Chattopadhyay obtained his B Tech and M Tech degree in 1987 and 1989 respectively from IIT Kharagpur. He obtained his PhD degree from Jadavpur University in 1993. He served as a faculty in the Department of Computer Science and Engineering, Jadavpur University from 1989 to 1993. In 1993, he moved to industry and joined back the same department in Jadavpur University as an Associate Professor in 1997. Since 2001, he is a Professor of Information Technology in Jadavpur University.

Prof. Chattopadhyay is also a visiting fellow of the University of Northumbria, Newcastle upon Tyne UK. He was an adjunct faculty at IIT Kharagpur for the Distributed Systems course and a visiting faculty member for the MTech course by IIT Kharagpur which was offered in distance learning mode.

Dr. Chattopadhyay has more than two decades of experience of serving reputed Industry houses including Mindware, Computer Associates TCG Software, Interra Systems India Ltd. He is also a project consultant of the prestigious National Digital Library Mission of Government of India.

Prof. Chattopadhyay has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Ad hoc Wireless Networks, Cloud Computing. Dr. Chattopadhyay has been a co-faculty in Database Management Systems in NPTEL-NOC.

Prof. Chattopadhyay has published over 60 technical papers in international journals in the areas of Wireless Networks, Network Security, Machine learning applications. He has co-authored a research monograph titled 'Digital Geometry in Image Processing', a textbook titled 'Data Structures through C' and 'Big Data in e-Healthcare'. His current research interests include Network Security, Machine learning, Wireless network and Pervasive computing.

COURSE PLAN :

Week 1: Course Overview, Introduction to RDBMS

Week 2: Structured Query Language (SQL)

Week 3: Relational Algebra, Entity-Relationship Model

Week 4: Relational Database Design

Week 5: Application Development, Case Studies, Storage and File Structure

Week 6: Indexing and Hashing, Query Processing

Week 7: Query Optimization, Transactions (Serializability and Recoverability)

Week 8: Concurrency Control, Recovery Systems, Course Summarization



DATA SCIENCE FOR ENGINEERS

PROF. RAGUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PROF. SHANKAR NARASIMHAN

Department Of Chemical Engineering
IIT Madras

PRE-REQUISITES : 10 hrs of pre-course material will be provided, learners need to practise this to be ready to take the course.

INTENDED AUDIENCE : Any interested learner

INDUSTRY SUPPORT : HONEYWELL, ABB, FORD, GYAN DATA PVT. LTD

COURSE OUTLINE :

Learning Objectives :

- Introduce R as a programming language
- Introduce the mathematical foundations required for data science
- Introduce the first level data science algorithms
- Introduce a data analytics problem solving framework
- Introduce a practical capstone case study

Learning Outcomes:

- Describe a flow process for data science problems (Remembering)
- Classify data science problems into standard typology (Comprehension)
- Develop R codes for data science solutions (Application)
- Correlate results to the solution approach followed (Analysis)
- Assess the solution approach (Evaluation)
- Construct use cases to validate approach and identify modifications required (Creating)
-

ABOUT INSTRUCTOR :

Prior to joining IIT Madras as a professor, **Prof.Rengaswamy** was a professor of Chemical Engineering and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

Prof.Shankar Narasimhan is currently a professor in the department of Chemical Engineering at IIT Madras. His major research interests are in the areas of data mining, process design and optimization, fault detection and diagnosis and fault tolerant control. He has co-authored several important papers and a book titled Data Reconciliation and Gross Error Detection: An Intelligent Use of Process Data which has received critical appreciation in India and abroad.

COURSE PLAN :

Week 1: Course philosophy and introduction to R

Week 2: Linear algebra for data science

1. Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse)
2. Geometric view - vectors, distance, projections, eigenvalue decomposition

Week 3: Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)

Week 4: Optimization

Week 5: 1. Optimization

2. Typology of data science problems and a solution framework

Week 6: 1. Simple linear regression and verifying assumptions used in linear regression

2. Multivariate linear regression, model assessment, assessing importance of different variables, subset selection

Week 7: Classification using logistic regression

Week 8: Classification using kNN and k-means clustering



DESCRIPTIVE STATISTICS WITH R SOFTWARE

Prof. Shalabh

Department of Mathematics
IITK

Prof. Prashant Jh

Department of Mathematics
NIT

INTENDED AUDIENCE: UG students of Science and Engineering. Students of humanities with basic mathematical and statistical background can also do it. Working professionals in analytics can also do it.

PRE-REQUISITES: Mathematics background up to class 12 is needed. Some minor statistics background is desirable

INDUSTRIES SUPPORT : All industries having R & D set up will use this course.

COURSE OUTLINE :

Any data analysis is incomplete without statistics. After getting the data, any statistical analysis starts with descriptive statistics which aims to extract the information hidden inside the data. The tools of descriptive statistics are based on mathematical and statistical functions which are to be evaluated using the software. The statistical software are paid as well as free. Most of the statistical software are paid software. A popular free statistical software is R. What are the basic tools of descriptive statistics and how to use the R software for descriptive statistical analysis is the objective of the course to be taught

ABOUT INSTRUCTOR :

Prof. Shalabh is a Professor of Statistics at IIT Kanpur. His research areas of interest are linear models, regression analysis and econometrics. He has more than 23 years of experience in teaching and research. He has developed several web based and MOOC courses in NPTEL including on regression analysis and has conducted several workshops on statistics for teachers, researchers and practitioners. He has received several national and international awards and fellowships. He has authored more than 75 research papers in national and international journals. He has written four books and one of the book on linear models is co-authored with Prof. C.R. Rao.

Prof. Prashant Jha is an Assistant Professor in the Department of Mathematics at NIT Sikkim. His research areas of interest are nonparametric regression, and shape restricted regression. He has recently completed his Ph.D. from the Department of Mathematics and Statistics, IIT Kanpur. He has worked as a Teaching Assistant in several MOOC courses in NPTEL including Introduction to R software and Descriptive statistics with R software. He has received NBHM Research Award, and CSIR fellowship for Research during his Ph.D.

COURSE PLAN :

Week 1: Calculations with R Software

Week 2: Introduction to Descriptive Statistics, frequency distribution

Week 3: Graphics and Plots

Week 4: Central Tendency of Data

Week 5: Variation in Data

Week 6: Moments, Association of Variables

Week 7: Association of Variables

Week 8: Association of Variables, Fitting of Linear Models



DESIGN FOR INTERNET OF THINGS

PROF. TV PRABHAKAR

Department of DESE

IISc

TYPE OF COURSE : New | Elective | PG

COURSE DURATION : 8 Weeks (26-Jul' 21 - 17-Sep' 21)

EXAM DATE : 26 Sep 2021

COURSE OUTLINE :

An overview of IOTs, design of smart objects that provide collaboration and ubiquitous services will be explored. Design for longevity/energy efficiency will be highlighted. Step by step system design will be introduced. Small video chips that will allow students to prototype will be displayed. At the end of the course, the student is expected to make the right choice of hardware, software and protocols for the proposed application.

ABOUT INSTRUCTOR :

Prabhakar is a Principal Research Scientist at IISc. He works in the area of Networked Embedded Systems where he focuses on hardware system design, micro energy harvesting systems and power management algorithms. Prabhakar leads the effort in Zero Energy Networks Laboratory (Zenlab) at DESE, IISc, where his PhD, master's students, project associates and interns work on building embedded electronic systems for application areas such as Airplane cabin, Industrial IoT, Air Quality, Tactile Internet applications, Autonomous drone charging systems, Machine Learning and AI for IoT applications.

COURSE PLAN :

Week 1: Introduction to IoT – Definition, Applications, Challenges – Unique ID, Power, Security, Location

Week 2: Addressing the Power challenge – RFID, Energy harvesting, Battery based systems, Power management systems

Week 3: System design for low power – LDO, DC-DC converters, low power software

Week 4: Sensors and actuators – Temperature sensor, Air quality, Solenoid valves

Week 5: Power management algorithms

Week 6: IoT protocols – MQTT, COAP, and Websockets with associated applications

Week 7: Low power wireless technologies – BLE, IEEE 802.15.4e, Wi-Fi

Week 8: Low Power Wire area technologies – NBIoT, CAT – LTE-M1, , LORA



DESIGN PRACTICE

PROF. SHANTANU BHATTACHARYA

Department of Mechanical Engineering
IIT Kanpur

INTENDED AUDIENCE : Students and Faculty of BE/ME/MS/BSc/MSc streams

INDUSTRY SUPPORT : SMIL (Gurgaon), HAL Kanpur and Lucknow, Small & medium scale production industries

COURSE OUTLINE

The course is intended for beginners in post graduate studies in Design. It can also serve well for aspiring professionals in industry who will be willing to undertake careers in the field of design.

ABOUT INSTRUCTOR

Prof. Shantanu Bhattacharya is currently as Associate Professor at the Department of Mechanical Engineering at the Indian Institute of technology Kanpur. Prior to joining the department he has been associated at a senior management level at Suzuki Motors and has over 6 years of experience in various production capacities and positions. Prof. Bhattacharya currently takes care of the 4-I laboratory at IIT Kanpur as its coordinator and has also been associated with the TA202 laboratory as coordinator between 2012-2015. Both these laboratories are very high end in terms of offering manufacturing training programs

COURSE PLAN

Week 1: Introduction to Design/Product design

Week 2: Stanford model of Design thinking/ Stages of engineering design of products/Introduction to Concurrent engineering

Week 3: Concurrent engineering Approaches: Benefits, influencing factors

Week 4: Product Development Methodology: Concurrent engineering in Practice

Week 5: Product embodiment design(robustness of design/Average Quality loss)

Week 6: Material selection process in design

Week 7: House of quality, Specifications (Fits and Tolerances), Axiomatic Design

Week 8: Introduction to Group Technology, Creating forms and shapes, Introduction to electronics



DEVELOPING SOFT SKILLS AND PERSONALITY

PROF. T. RAVICHANDRAN

Department of Humanities and Social Sciences
IIT Kanpur

INTENDED AUDIENCE : Students, Teachers, Professionals, Trainers, Leaders, Employers

INDUSTRIES APPLICABLE TO : All industries/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

COURSE OUTLINE :

The course aims to cause a basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfillment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills.

ABOUT INSTRUCTOR :

Prof. T. RAVICHANDRAN is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad

COURSE PLAN:

Week 1: Lecture 1: Introduction: A New Approach To Learning

Lecture 2: Planning And Goal-Setting

Lecture 3: Human Perceptions: Understanding People

Lecture 4: Types Of Soft Skills: Self-Management Skills

Lecture 5: Aiming For Excellence: Developing Potential And Self-Actualisation

Lecture 6: Need Achievement And Spiritual Intelligence

Week 2: Lecture 7: Conflict Resolution Skills: Seeking Win-Win Solution

Lecture 8: Inter-Personal Conflicts: Two Examples

Lecture 9: Inter-Personal Conflicts: Two Solutions

Lecture 10: Types Of Conflicts: Becoming A Conflict Resolution Expert

Lecture 11: Types Of Stress: Self-Awareness About Stress

Lecture 12: Regulating Stress: Making The Best Out Of Stress

- Week 3:** **Lecture 13:** Habits: Guiding Principles
Lecture 14: Habits: Identifying Good And Bad Habits
Lecture 15: Habits: Habit Cycle
Lecture 16: Breaking Bad Habits
Lecture 17: Using The Zeigarnik Effect For Productivity And Personal Growth
Lecture 18: Forming Habits Of Success
- Week 4:** **Lecture 19:** Communication: Significance Of Listening
Lecture 20: Communication: Active Listening
Lecture 21: Communication: Barriers To Active Listening
Lecture 22: Telephone Communication: Basic Telephone Skills
Lecture 23: Telephone Communication: Advanced Telephone Skills
Lecture 24: Telephone Communication: Essential Telephone Skills
- Week 5:** **Lecture 25:** Technology And Communication: Technological Personality
Lecture 26: Technology And Communication: Mobile Personality?
Lecture 27: Topic: Technology And Communication: E-Mail Principles
Lecture 28: Technology And Communication: How Not To Send E-Mails!
Lecture 29: Technology And Communication: Netiquette
Lecture 30: Technology And Communication: E-Mail Etiquette
- Week 6:** **Lecture 31:** Communication Skills: Effective Communication
Lecture 32: Barriers To Communication: Arising Out Of Sender/Receiver's Personality
Lecture 33: Barriers To Communication: Interpersonal Transactions
Lecture 34: Barriers To Communication: Miscommunication
Lecture 35: Non-Verbal Communication: Pre-Thinking Assessment-1
Lecture 36: Non-Verbal Communication: Pre-Thinking Assessment-2
- Week 7:** **Lecture 37:** Nonverbal Communication: Introduction And Importance
Lecture 38: Non-Verbal Communication: Issues And Types
Lecture 39: Non-Verbal Communication: Basics And Universals
Lecture 40: Non-Verbal Communication: Interpreting Non-Verbal Cues
Lecture 41: Body Language: For Interviews
Lecture 42: Body Language: For Group Discussions
- Week 8:** **Lecture 43:** Presentation Skills: Overcoming Fear
Lecture 44: Presentation Skills: Becoming A Professional
Lecture 45: Presentation Skills: The Role Of Body Language
Lecture 46: Presentation Skills: Using Visuals
Lecture 47: Reading Skills: Effective Reading
Lecture 48: Human Relations: Developing Trust And Integrity



DIGITAL ELECTRONIC CIRCUITS

PROF. GOUTAM SAHA

Department of Electronics
& Communication Engineering
IIT Kharagpur

PRE-REQUISITES : Basic understanding of diode, transistor operation. If this is not covered in 10+2 Board of the students then the same may be studied from Basic Electronics or Analog Electronic Circuits course.

INTENDED AUDIENCE : Electronics, Electrical, Instrumentation, Computer Science

COURSE OUTLINE :

There is a notable increase in the use of the word 'digital' for products and services that are becoming part of our everyday life. Examples are digital camera, digital watch, digital weighing machine, digital signature, digital payment, digital art and so on. The digital prefix associates a term with digital technology and is considered a step up in the delivered performance at a given cost. The world of digital provides easy storage and reproduction, immunity to noise and interference, flexibility in processing, different transmission options, and very importantly, inexpensive building blocks in the form of integrated circuits. Digital systems represent and manipulate digital signals. Such signals represent only finite number of discrete values. A signal can be discrete by nature whereas, a continuous signal can be discretized for digital processing and then converted back. Manipulation and storage of digital signal involves switching. This switching is done through electronic circuits. Basic gates made from electronic circuits are primary building blocks of digital systems. These gates combine in different ways to develop digital circuits that are associated with different functionalities. This is helped by an understanding of Boolean Algebra. The functional blocks in turn, combine to generate a complex digital system. There are general purpose programmable blocks, too. This course is aimed at developing a deep understanding of digital electronic circuits. At the end of the course, one would be able to analyze and synthesize different kind of combinatorial and sequential digital systems for real-world use.

ABOUT INSTRUCTOR :

Prof. Goutam Saha, BTech, PhD from IIT Kharagpur had a short Management Training at XLRI, Jamshedpur. During 1990-1994, he worked with Tata Steel. He joined as faculty member in the Dept. of Electronics and Electrical Communication Engineering at IIT Kharagpur in 2002. In 2006 fall semester, he served University of Southern California, USA. His research interest includes biomedical and speech signal processing with collaborations from India and abroad. His work was declared a winner in DST-Lockheed Martin India Innovation Growth Program, selected for Rashtrapati Bhavan exhibition, became editorial article of peer reviewed research journal, features in India Innovates Youtube channel and was also covered in leading media. He has published papers in leading international journals and conference proceedings, filed several patents and co-authored two popular textbooks published by McGraw-Hill Education. He has a decade long experience of teaching the 'Digital Electronic Circuits' course to IIT Kharagpur undergraduates.

COURSE PLAN :

Week 1 : Introduction; Relation between switching and logic operation; Use of Diode and Transistor as switch; Concept of noise margin, fanout, propagation delay; TTL, Schottky TTL, Tristate; CMOS Logic, Interfacing TTL with CMOS

Week 2 : Basic logic gates, Universality of NAND, NOR gates, AND-OR-Invert gates, Positive and Negative Logic; Boolean Algebra axioms and basic theorems; Standard and canonical representations of logic functions, Conversion between SOP and POS; Simplification of logic functions, Karnaugh Map, Don't Care Conditions

Week 3 : Minimization using Entered Variable Map, Minimization using QM algorithm; Cost criteria, Minimization of multiple output functions; Static-0, Static-1 and Dynamic Hazards and their cover.

Week 4 : Multiplexer; Demultiplexer / Decoder, BCD to 7-segment decoder driver; Encoder, Priority encoder; Parity generator and checker

Week 5 : Number systems-binary, Signed binary, Octal, hexadecimal number; Binary arithmetic, One's and two's complements arithmetic; Codes, Code converters; Adder, Subtractor, BCD arithmetic

Week 6 : Carry look ahead adder; Magnitude comparator; ALU; Error detecting and correcting codes

Week 7 : Bistable latch, SR, D, JK, T Flip-Flop: level triggered, edge triggered, master – slave, Various representations of flip-flops; Analysis and synthesis of circuits that use flip-flop

Week 8 : Register, Shift register, Universal shift register; Application of shift register: ring counter, Johnson counter, sequence generator and detector, serial adder; Linear feedback shift register

Week 9 : Up and down counter, Ripple (asynchronous) counters, Synchronous counters; Counter design using flip flops, Counter design with asynchronous reset or preset; Applications of counters

Week 10 : Design of synchronous sequential circuit using Mealy model and Moore model: state transition diagram, algorithm state machine (ASM) chart; State reduction technique

Week 11 : Digital to analog converters: weighted resistor/converter, binary ladder, converter, accuracy and resolution; Analog to digital converter: quantization and encoding, different types of conversion, accuracy and resolution

Week 12 : Memory organization and operation, Memory expansion; Memory cell; Different types of memory, ROM, PROM, PAL, PLA, CPLD, FPGA



ELECTRIC VEHICLES - PART 1

PROF. AMIT JAIN

Department of Electrical Engineering
IIT Delhi

PRE-REQUISITES : BE (Electrical)

INTENDED AUDIENCE : Interested Students

COURSE OUTLINE :

This course will be a first level course on electric vehicle. Students will be able to understand the operation of battery driven electric vehicle. The course will start with introduction section which will enable the students to understand the focus areas that come under the umbrella of electric vehicles. Then the course will start covering this focus areas one by one such as vehicle dynamics, Motors, Power Electronics, Batteries, Charging etc. The most important part of this course will be that each topic will be analyzed and demonstrated through Matlab Simulink, so that the grip of the subject will be strong and the knowledge acquired will be useable in real time applications.

ABOUT INSTRUCTOR :

Prof. Amit Kumar Jain is presently working as Associate Professor in Department of Electrical Engineering, IIT Delhi. He is done his Ph.D and M.S from Department of Electrical Engineering, I.I.Sc, Bangalore and spend around two years in General Electric Global Research Center before joining IIT Delhi in 2012. He expertise includes electric drives for renewable and electric vehicle application. He has also started a course on Electric Vehicles in IIT Delhi which is now been converted to NPTEL video course.

COURSE PLAN :

Week 1: Introduction to Electric Vehicle

Week 2: Vehicle Dynamics: Modelling and Simulation

Week 3: Fundamental of Drives and DC Machine Modeling

Week 4: DC Machine Drives and Control of EV Using DC Machine



ELECTRONICS ENCLOSURES THERMAL ISSUES

PROF. N. V. CHALAPATHI RAO

Department of Electronic Systems Engineering
IISc Bangalore

PRE-REQUISITES :12th Standard

INTENDED AUDIENCE : Registrants to BSc, BE, B.Tech, MSc and ME, M.Tech courses, Product design engineers (in related industry) Product Managers

INDUSTRIES APPLICABLE TO : Electronics and Mechanical involved in enclosure Design

COURSE OUTLINE : Electronics Design is understood as analysis and implementation at various levels from large systems installation to chip design. One of the aspects is failure due to temperature effects is constantly under study. Theory of Heat transfer has been understood and explained way back in 1700. Rigor and precision has resulted in seemingly complicated 'equations'. In the design of enclosures, managing heat is (relatively) well understood. Empirical results can be used to optimise the layout and reduce failure. Practices in use of heat management hardware are available from specialist manufacturers and can be used. This course is an attempt to familiarise the participating registrants with heat related issues in Design of Electronic Product enclosures.

ABOUT INSTRUCTOR :

Prof. N.V.Chalapathi Rao has worked in Defense R & D for 8 years. Has been delivering lectures since 1984 on topics related to equipment design at CEDT, DESE and CPDM of IISc. Has guided and built more than 100 projects at M. Tech level

COURSE PLAN :

1. Introduction to Enclosures and thermal issues
2. Basics of conductive heat transfer
3. Radiation at normal ambient
4. Convection basics
5. Forced convection
6. Combined modes
7. Use of Conduction in enclosures
8. Radiation as a speciality
9. Convective cooling in small products
10. Forced cooling in medium and large systems
11. Liquid cooled high power modules
12. Novelty phase change and thermo electrics
13. Refrigerated cabinets
14. Heat sinks practical application
15. Blowers, fans, ventilations of systems
16. Instrumentation for measurement
17. Effects on sealed enclosures
18. Integration of ID with the heat aspects
19. Case stories in biological instruments
20. Case study of select participants' work
21. Application of Thermal CAD and round up



EMOTIONAL INTELLIGENCE

PROF. RABINDRA KUMAR PRADHAN

Department of Humanities and Social Sciences

IIT Kharagpur

INTENDED AUDIENCE : Engineering, Management, Social Sciences and Law students

INDUSTRIES APPLICABLE TO : Human resource management division, training & development division of both manufacturing and service industries, MBA and HRM students

COURSE OUTLINE :

"Intelligence quotient (IQ) gets you hired but emotional quotient (EQ) gets you promoted". This popular quote by Times magazine during late nineties has made the concept of emotional intelligence more popular among people by highlighting its multiple implications and applications. The uses and utility of emotional intelligence at home, school and workplace have benefited thousands in many disciplines. This course is designed to sensitize the participants about the concept, theory and applications of emotional intelligence. The participants will get to know the added advantage of EQ the software of the brain over the hardware (IQ). This programme will also explore how our hearts rule over our heads for creative creation. It will also focus on how various principles of emotional intelligence guide us in different contexts of life. The awareness about the credo of emotional intelligence will develop insights into self-regulation and realization of one's optimum potentials for better performance. The participants will come to know about many unknowns of life, which will further help them to enhance their awareness to be effective on their roles. The course will offer useful lessons with the help of practical exercises, games, audio-visual instruments, case studies, classroom interaction to show the road map how to foster emotional intelligence in organisation for achieving health, happiness and optimal performance at work.

ABOUT INSTRUCTOR :

Prof. Rabindra Kumar Pradhan is currently working as associate professor in the department of humanities and social sciences, Indian Institute of Technology Kharagpur. He is currently working in diverse areas of behavioral sciences and human resource management. He is actively involved in teaching, training & research in the fields of positive psychology, industrial and organizational psychology, human resource development and management, and organizational behavior. He has 18 years of experience in teaching, research and training. He has published 02 books on emotional intelligence, 01 book on human resource management and 01 book on human development through training. He has also published more than 70 journal articles and 22 book chapters. His research papers/articles have been published in international journal Emerald Insights, Inderscience Publishers, Sage, Springer, Taylor & Francis, etc. Recently, Dr. Pradhan has been awarded with the "best trainer award-2012" by ISTD, Hyderabad and "best teacher award-2013" by ISTD, Kolkata for outstanding contribution in training & HRD. Some of his research papers have been awarded as "best paper" in ICOM-2015, Abu Dhabi and IBRC-2015, India.

COURSE PLAN :

Week 1: Introduction to emotion, intelligence & wisdom

Week 2: Concept, theory, measurement and applications of intelligence

Week 3: Emotional intelligence: concept, theory and measurements

Week 4: Correlates of emotional intelligence

Week 5: Emotional intelligence, culture, schooling and happiness

Week 6: For enhancing emotional intelligence EQ mapping

Week 7: Managing stress, suicide prevention, through emotional intelligence, spirituality and meditation

Week 8: Application of emotional intelligence at family, school and workplace



ENHANCING SOFT SKILLS AND PERSONALITY

PROF.T. RAVICHANDRAN

Department of Humanities and Social Sciences
IIT Kanpur

INTENDED AUDIENCE : Students, Teachers, Professionals, Trainers, Leaders, Employers

INDUSTRIES APPLICABLE TO : All industry/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

COURSE OUTLINE :

The course aims to cause an enhanced awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfilment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The focus of this course is on interpersonal and management skills. It has been approved for "Faculty Development Programme" by AICTE.

ABOUT INSTRUCTOR :

Prof. T. Ravichandran is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad.

COURSE PLAN :

Week 1 : Highlights of Developing Soft Skills and Personality Course-1-24 ; Highlights of Developing Soft Skills and Personality Course-25-48 ; Definitions and Types of Mindset ; Learning Mindsets ; Secrets of Developing Growth Mindsets

Week 2 : Importance of Time and Understanding Perceptions of Time ; Using Time Efficiently ; Understanding Procrastination ; Overcoming Procrastination ; Don't Say "Yes" to Make Others Happy!

Week 3 : Types of People ; How to Say "No" ; Controlling Anger ; Gaining Power from Positive Thinking-1 ; Gaining Power from Positive Thinking-2

Week 4 : What Makes Others Dislike You? ; What Makes Others Like You?-1 ; What Makes Others Like You?-2 ; Being Attractive-1 ; Being Attractive-2

Week 5 : Common Errors-1 ; Common Errors-2 ; Common Errors-3 ; Common Errors-4 ; Common Errors-5

Week 6 : Humour in Communication ; Humour in the Workplace ; Function of Humour in the Workplace ; Money and Personality ; Managing Money

Week 7 : Health and Personality ; Managing Health-1: Importance of Exercise ; Managing Health-2: Diet and Sleep ; Love and Personality ; Managing Love

Week 8 : Ethics and Etiquette ; Business Etiquette ; Managing Mind and Memory ; Improving Memory ; Care for Environment ; Highlights of the Course



ETHICAL HACKING

PROF. INDRANIL SENGUPTA

Dept. of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : Computer Science and Engineering / Information Technology / Electronics and Communication Engineering / Electrical Engineering

PREREQUISITES : Basic concepts in programming and networking

INDUSTRIES APPLICABLE TO : TCS, Wipro, CTS, Google, Microsoft, Qualcomm

COURSE OUTLINE

Ethical hacking is a subject that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the participants. The participants are encouraged to try and replicate the demonstration experiments that will be discussed as part of the course.

ABOUT INSTRUCTOR

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on Reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

COURSE PLAN

Week 1: Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.

Week 2: IP addressing and routing. TCP and UDP. IP subnets.

Week 3: Routing protocols. IP version 6.

Week 4: Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool.

Week 5: Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

Week 6: Introduction to cryptography, private-key encryption, public-key encryption.

Week 7: Cryptographic hash functions, digital signature and certificate, applications.

Week 8: Steganography, biometric authentication, network-based attacks, DNS and Email security.

Week 9: Packet sniffing using Wireshark and Burpsuite, password attack using Burp suite. Social engineering attacks and Denial of service attacks.

Week 10: Elements of hardware security: side-channel attacks, physical in-cline functions, hardware trojans.

Week 11: Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution, etc. Attack on web servers: password attack, SQL injection, cross-site scripting.

Week 12: Case studies: various attack scenarios and their remedies.



FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES

PROF. SAJJAN KAPIL

Department of Mechanical Engineering
IIT Guwahati

INTENDED AUDIENCE : Bachelor/Master/PhD students having background in Mechanical Engineering/Production Engineering/Manufacturing Technology

COURSE OUTLINE :

The progress of additive manufacturing processes is ever increasing with the development of the digital platform in the manufacturing sector, which is essential for the growth of modern technologies. This course is primarily designed for fundamental understanding of different additive manufacturing technologies for realizing the metallic and non-metallic objects. The syllabus is oriented to cover from basic understanding to practical applications of this technology to develop the products. Therefore, the academic people, as well as the industrial practitioner both, will be benefitted from this course. The special emphasis is given to link computer interface with the digital manufacturing process and their demonstration using commercially available software. The modules cover almost all the direction of additive manufacturing technologies, and it is blended with fundamental development to the recent technologies. The audience will be able to develop a fundamental understanding of different perspectives and recent development in this field through the lectures, skill development through demonstration, and reinforce their knowledge by solving assignments. This course is presented in a lucid and simplified way to make it enjoyable to the beginners.

ABOUT INSTRUCTOR :

Prof. Sajjan Kapil completed his Bachelor's degree in Mechanical Engineering from G. B. Pant Engineering College Pauri, Master's degree in Computer Assisted Manufacturing from IIT Guwahati & University of Stuttgart and Ph.D. from IIT Bombay. After that, he joined the Department of Mechanical Engineering IIT Guwahati as an Assistant Professor. His areas of research include 3D printing, Manufacturing Automation, and CAD/CAM. At IIT Bombay, he had developed an Additive Manufacturing process called "Hybrid Layered Manufacturing". He had simplified the manufacturing process of complex geometries by generating both 3 and 5-axis metal deposition toolpaths. He has published his research work in 13 international journals, 7 Indian patents, and more than 20 conferences. He has developed a new elective course entitled as 'Additive Manufacturing Technologies' at IIT Guwahati. He is involved in teaching the subjects like 'Additive Manufacturing Technologies', 'Kinematics of Machinery', 'Engineering Drawing', and 'Manufacturing Laboratory', at IIT Guwahati.

COURSE PLAN :

- Week 1 :** Introduction to Additive Manufacturing
- Week 2 :** Computer Aided Process Planning for Additive Manufacturing
- Week 3 :** Computer Aided Process Planning for Additive Manufacturing
- Week 4 :** Liquid Additive Manufacturing
- Week 5 :** Liquid Additive Manufacturing
- Week 6 :** Sheet Additive Manufacturing
- Week 7 :** Wire Additive Manufacturing
- Week 8 :** Wire Additive Manufacturing
- Week 9 :** Wire Additive Manufacturing
- Week 10 :** Powder Additive Manufacturing
- Week 11 :** Powder Additive Manufacturing
- Week 12 :** Powder Additive Manufacturing



FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

PROF. SHYAMANTA M. HAZARIKA

Department of Mechanical Engineering
IIT Guwahati

PRE-REQUISITES : Basic Course in Probability and Linear Algebra

INTENDED AUDIENCE : Final Year B.Tech/M.Tech and PhD students

COURSE OUTLINE :

What does automatic scheduling or autonomous driving have in common with web search, speech recognition, and machine translation? These are complex real-world problems that span across various practices of engineering! Aim of artificial intelligence (AI) is to tackle these problems with rigorous mathematical tools. The objective of this course is to present an overview of the principles and practices of AI to address such complex real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

ABOUT INSTRUCTOR :

Prof. Shyamanta M Hazarika is a Professor of Mechanical Engineering at IIT Guwahati and leads the Biomimetic Robotics and Artificial Intelligence Lab. His research interest is in Rehabilitation Robotics. This translates into interest in Artificial Intelligence, Biomimetic Robotics and Robotic Neurorehabilitation. Prior to joining IIT Guwahati, he was with the Department of Computer Science and Engineering, Tezpur University. He has been a Vertretungsprofessur of Cognitive Systems and Neuroinformatics, University of Bremen, Germany. Prof. Hazarika holds a B.E. in Mechanical Engineering from Assam Engineering College, Guwahati, India; M.Tech. in Robotics from Center for Robotics, IIT Kanpur, India. He completed his PhD in Artificial Intelligence (Knowledge Representation and Reasoning) from School of Computing, University of Leeds, England.

COURSE PLAN :

Week 1: AI and Problem Solving by Search

Week 2: Problem Solving by search

Week 3: Problem Solving by search (contd)

Week 4: Knowledge Representation and Reasoning

Week 5: Knowledge Representation and Reasoning (Contd)

Week 6: Knowledge Representation and Reasoning (contd)

Week 7: Reasoning under uncertainty

Week 8: Planning

Week 9: Planning and Decision Making

Week 10: Machine Learning

Week 11: Machine Learning (contd)

Week 12: Machine Learning (contd)



FUNDAMENTALS OF AUTOMOTIVE SYSTEMS

PROF. C. S. SHANKAR RAM

Department of Design Engineering

IIT Madras

PRE REQUISITES: Rigid Body Dynamics (done in 1st year BE), Thermodynamics, Fluid Mechanics

INTENDED AUDIENCE: 3rd/4th year undergraduate and 1st year M.Tech./M.S./Ph.D. students

COURSE OUTLINE :

The objective of this course is to provide a fundamental understanding of the various systems of a typical automobile.

Course Outcomes: At the end of this course, the participant should be able to:

1. acquire fundamental knowledge of the various systems of an automobile,
2. associate the functions of each system with its design and layout, depict the various systems using simple schematics, and apply concepts learnt in core undergraduate courses to synthesize mathematical models of the various systems.

ABOUT INSTRUCTOR :

Prof. C. S. Shankar Ram is currently a professor in the Department of Engineering Design, Indian Institute of Technology Madras, Chennai, India. He received his Bachelor of Engineering (B. E.) in Mechanical Engineering from Motilal Nehru Regional Engineering College, Allahabad, India, and his M. S. and Ph. D. from Texas A&M University, USA. His research interests are in the areas of dynamics and control with applications to automotive and transportation systems. He teaches courses on Control Systems, Fundamentals of Automotive Systems and Control of Automotive Systems at IIT Madras

COURSE PLAN :

Week 1 : Course Overview, Classification of Internal Combustion Engines, Engine Components, Operation of Four Stroke Engines

Week 2 : Two Stroke Engines, Engine Cycles

Week 3 : Engine Performance, Supercharging, Combustion in Spark Ignition Engines

Week 4 : Combustion in Compression Ignition Engines, Carburetion, Fuel Introduction Systems

Week 5 : Engine Emissions, Emission Control Systems, Automotive Powertrain

Week 6 : Automotive Clutch, Transmission, Powertrain Analysis

Week 7 : Transmission Matching and Introduction to Brake System

Week 8 : Components of Brake System, Hydraulic Brake

Week 9 : Air Brake, Antilock Brake System

Week 10 : Braking Analysis, Introduction to Steering System, Manual Steering System

Week 11 : Power Steering System, Wheel Alignment, Introduction to Suspension System

Week 12 : Components of Suspension System, Dependent and Independent Suspension, Introduction to Electric and Hybrid Powertrain, Tyres.



GERMAN - I

PROF. MILIND BRAHME

Department of Humanities and Social Sciences
IIT Madras

INTENDED AUDIENCE : Anyone interested in learning elementary German

INDUSTRIES APPLICABLE TO : Companies / Organisations / Individuals having business / work with Germany, Austria and/or Switzerland

COURSE OUTLINE :

German I is meant to be an introduction to the German language and a basic orientation towards Germany (and to some extent Austria and Switzerland). Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of Germany as a cultural space are the overall objectives of the course. Serious learners should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

ABOUT INSTRUCTOR :

Prof. Milind Brahme has an MA, M Phil and a PhD in German language and literature from the Centre of German Studies, JNU. He has been on the faculty of IIT Madras since 2003, and has more than 25 years of experience of teaching German language and literature in diverse situations and contexts.

COURSE PLAN :

Week 1: Themes: Introducing oneself and others; Grammar: W questions, personal pronouns, simple sentence, verb conjugation

Week 2: Themes: hobbies, the week, numbers, the alphabet, months, seasons / Grammar : articles , plural, the verbs to have and to be

Week 3: Theme: In the city / naming places and buildings, means of transport, basic directions / Grammar : definite and indefinite articles; negation - kein and nicht; imperative

Week 4: Themes: food, drink, family / groceries and meals / Grammar : the accusative

Week 5: Theme: Everyday life, telling time, making appointments / Grammar : prepositions am, um, von..bis; modal verbs, possessive articles

Week 6: Leisure activity, celebrations / Grammar: separable verbs, the accusative, past tense of to have and to be

Week 7: Contacts, writing letters / Grammar: dative

Week 8: My apartment, rooms, furniture, colours / Grammar: changing prepositions

Week 9: Professions / Grammar : perfect tense

Week 10: Clothes / Grammar: perfect tense and dative

Week 11: Health and the body / Grammar: the imperative and modal verbs

Week 12: Holiday and weather

HEALTH RESEARCH FUNDAMENTALS

MULTI FACULTY

PRE-REQUISITES : Undergraduate students in medical/dental/nursing/AYUSH streams Graduate in any discipline

INTENDED AUDIENCE : Any current or potential health researcher

INDUSTRIES APPLICABLE TO : Government/ private sector, public health service institutions/ agencies, Post graduate institutions in biomedical and allied sciences, Medical colleges/ Universities, NGOs engaged in health research, Clinical research organizations, Pharma companies and marketing research organizations

COURSE OUTLINE :

ICMR - National Institute of Epidemiology is offering online programmes on conduct of human bio-medical research. The programme will be offered as NIE-ICMR e-Certificate – NleCer - Courses. The first in this series, NleCer 101:Health Research Fundamentals, is a basic level course in health research methods. It will explain the fundamental concepts in epidemiology and bio-statistics related to research methods. This course will provide an overview of steps and principles for designing bio-medical and health research studies among human participants. We expect this course to be useful for individuals interested in pursuing health research in the roles of study investigators, clinical/public health researchers (physicians, counselors, research associates, social scientists, nurses, pharmacists, technicians, data and quality managers etc.), scientists, ethics committee members and project managers.

ABOUT INSTRUCTOR :

Dr. Sanjay Mehendale, MD, MPH, FAMS, FIMSA, FACE
Ex - Additional Director General, ICMR

Dr. Manoj Murhekar, MD
Scientist 'G' & Director, ICMR - National Institute of Epidemiology

Dr. R Ramakrishnan, MAE, PhD
Formerly Scientist 'G', ICMR - National Institute of Epidemiology

Dr. Prabhdeep Kaur, MAE, DNB
Scientist 'E', ICMR - National Institute of Epidemiology

Dr. Tarun Bhatnagar, MD, PhD
Scientist 'E', ICMR - National Institute of Epidemiology

Dr. P. Manickam, BSMS, M.Sc., PhD
Scientist 'E', ICMR - National Institute of Epidemiology

Dr. P. GaneshKumar, MD
Scientist 'C', ICMR - National Institute of Epidemiology

All the instructors are faculty members for the two-year Master of Public Health [MPH] programme at the ICMR School of Public Health of the NIE, Chennai, India. The School is offering MSc (Biostatistics) from this July. Besides the Master's level programmes, the faculty members have been conducting PG diploma and various short-term training programmes in public health/epidemiology and biostatistics. Besides teaching, the faculty members have been conducting epidemiological/public health research.

COURSE PLAN :

- Week 1: Conceptualizing a research study
 Introduction to health research – Dr. Sanjay Mehendale
 Formulating research question, hypothesis and objectives – Dr. P Manickam
 Literature review – Dr. P Ganeshkumar
- Week 2: Epidemiological considerations in designing a research study (1/2)
 Measures of disease frequency - Dr. R Ramakrishnan
 Descriptive study designs - Dr. Prabhdeep Kaur
 Analytical study designs - Dr. Manoj Murhekar
- Week 3: Epidemiological considerations in designing a research study (2/2)
 Experimental study designs: Clinical trials - Dr. Sanjay Mehendale
 Validity of epidemiological studies - Dr. Tarun Bhatnagar
 Qualitative research methods: An overview - Dr. Tarun Bhatnagar
- Week 4: Bio-statistical considerations in designing a research study
 Measurement of study variables – Dr. R Ramakrishnan
 Sampling methods – Dr. R Ramakrishnan
 Calculating sample size and power – Dr. R Ramakrishnan
- Week 5: Planning a research study (1/2)
 Selection of study population – Dr. P Ganeshkumar
 Study plan and project management – Dr. Sanjay Mehendale
 Designing data collection tools – Dr. Tarun Bhatnagar
- Week 6: Planning a research study (2/2)
 Principles of data collection – Dr. Prabhdeep Kaur
 Data management – Dr. P Manickam
 Overview of data analysis - Dr. P Manickam
- Week 7: Conducting a research study
 Ethical framework for health research – Dr. Sanjay Mehendale
 Conducting clinical trials - Dr. Sanjay Mehendale
- Week 8: Writing a research protocol
 Preparing a concept paper for research projects – Dr. P Manickam
 Elements of a protocol for research studies – Dr. Tarun Bhatnagar
 Publication ethics – Dr. Sirshendu Chaudhuri
 Manuscript writing – Dr. Jayashree K
 Grant proposal writing – Dr. S.A. Rizwan



INNOVATION BY DESIGN

PROF. B.K. CHAKRAVARTHY

Department of Design Engineering
IIT Bombay

INTENDED AUDIENCE : Open to all

COURSE OUTLINE :

In today's world, there are so many challenges and problems that need to be addressed. In this situation, innovation is what provides the solution that will benefit the maximum number of users. And such innovation is often enabled by design. This course familiarizes you with the concept of "innovation" and the journey of a design idea from the identification of a problem to a final solution that has a positive impact on a large community of users. Through case studies that focus on the "seven concerns of innovation", you learn how the innovation process requires empathy, meticulous effort, constant user interaction and effective collaboration.

ABOUT INSTRUCTOR :

Prof. B. K. Chakravarthi teaches Innovation by Design at the Industrial Design Centre (IDC), IIT Bombay. He has set up the Shenoy Innovation Studio at IITB, where students and young designers are given the opportunity to work on live projects and benefit from expertise in a range of interrelated fields. Prof. Chakravarthi works closely with other academics engaged in cutting-edge research at IIT Bombay and has played a key role in translating such research into products that reach the hands of users. A Collaborative Model for New Product Innovation, an outcome of Prof. Chakravarthi's doctoral research, has had wide application in the industry. Prof. Chakravarthi has also worked frequently with government departments and occupational communities engaged in essential services.

COURSE PLAN :

Week 1 :

- Module 1 – Introduction,
- Module 2 - First C: The Cause

Week 2 :

- Module 3 - Second C: The Context,
- Module 4 - Third C: The Comprehension

Week 3 :

- Module 5 - Fourth C: The Check,
- Module 6 - Fifth C: The Conception

Week 4 :

- Module 7 - Sixth C: The Crafting,
- Module 8 - Seventh C: The Connection



INTRODUCTION TO ABRASIVE MACHINING AND FINISHING PROCESSES

PROF. MAMILLA RAVI SANKAR

Department of Mechanical Engineering
IIT Tirupati

INTENDED AUDIENCE : BE/B.Tech, ME/ M.Tech, Ph. D (Mechanical Engineering, Production Engineering).
Faculty who teaches manufacturing.

INDUSTRIES APPLICABLE TO : Oil India Ltd., ONGC, TATA motors, ISRO, BARC, DRDL, NTPC,
CMTI, CMERI, CGCRI, Grind Master, NRL

COURSE OUTLINE :

This course will define the areas of application of traditional as well as non-traditional abrasive finishing processes in the manufacturing industry. The lectures will introduce the basic principles of material removal by use of abrasives particles and material removal mechanism of different abrasive process. The effects of various input parameters on the outputs as well as the use of cutting fluids in various finishing process will be discuss. A variety of numerical problems and MCQs, discussions will also be included.

ABOUT INSTRUCTOR :

Prof. Mamilla Ravi Sankar is currently an Assistant Professor in the Department of Mechanical Engineering, IIT Guwahati. He did his B.Tech from Sri Venkateswara University, Tirupati, and M.Tech as well as PhD from IIT Kanpur. His research group is focus on Sustainable Manufacturing, Eco-friendly Cutting fluids, Coatings, Advanced Manufacturing, Tribology and Rheology. MRS Lab also involves in development of lab scale Innovations to Commercial Manufacturing Products. He has published over 30 research articles in internationally reputed journals, 2 Patents, 2 Edited Books and 6 Book chapters. He is recipient of prestigious awards such as Institution of Engineers India (IEI) Young Engineers Award-2015 in Production Engineering, Indian Society for Advancement in Materials and Process Engineering (ISAMPE)-2011 and finalist of Indian National Academy of Engineering (INAE) Young Engineer Award-2014. Apart from academic awards, he is also received Institute Blues (Outstanding Sports Personality) of IIT Kanpur for the year 2009.

COURSE PLAN :

Week 1: Introduction conventional abrasive processes, Introduction to abrasive processes, Grinding Process

Week 2: Conventional abrasive finishing processes (CAFP): Honing & Wire Brushing, CAFP: Lapping, Buffing & Super finishing, Practical Conventional abrasive finishing processes

Week 3: Adv. abrasive machining processes (AAMP), AAMP

Week 4: Hybrid Adv. Abrasive Machining Processes, Advanced Finishing

Week 5: Adv. Finishing: Abrasive Flow Finishing

Week 6: Adv. Finishing: Magnetic Abrasive Finishing

Week 7: Adv. Finishing: Magnetic Rheological Finishing

Week 8: Hybrid abrasive finishing, Finishing of Advanced Materials



INTRODUCTION TO COGNITIVE PSYCHOLOGY

PROF. NAVEEN KASHYAP

Department of Humanities and Social Sciences
IIT Guwahati

INTENDED AUDIENCE : UG/PG/PhD students

COURSE OUTLINE :

One of the most puzzling fact for humans over the centuries has been the understanding of human behavior. Understanding and predicting human behavior will helps humans in exerting more control over situations. The bases of human behavior are the cognitive processes underlying them. The present course is an attempt to discuss and understand the basic cognitive processes that guide human behavior. The knowledge from the course will be useful in tackling everyday problems and attaining optimal solutions. Additionally, we can use knowledge about human cognitive systems in designing sophisticated Artificial Intelligence (AI) systems that learn from mistakes and make our lives a lot easier to live.

ABOUT INSTRUCTOR :

Prof. Naveen Kashyap, Ph.D is as Associate Professor of Psychology at the Indian Institute of Technology Guwahati. His research interests are sleep and human cognitive processes. Dr Kashyap has been teaching courses like cognitive psychology, introduction to psychology, consumer psychology, advance cognitive process and research methodology to UG and PG students of IITG Guwahati for the past 10 years.

COURSE PLAN :

Week 1: History, Theory and Research in Human Cognition

Week 2: Object Perception and Recognition

Week 3: Attentional Processes and cognition

Week 4: Memory Introduction

Week 5: Long Term Memory

Week 6: Memory of general knowledge

Week 7: Concept Formation

Week 8: Visual and Spatial Memory

Week 9: Human language skills

Week 10: Thought process and Problem Solving

Week 11: Reasoning

Week 12: Decision Making



INTRODUCTION TO INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic programming knowledge

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engineering, Industrial Engineering

COURSE OUTLINE :

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN :

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud Computing(contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring



INTRODUCTION TO MACHINE LEARNING - IITKGP

PROF. SUDESHNA SARKAR

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : Elective course for UG, PG, BE, ME, MS, M.Sc, PhD

PRE-REQUISITES : Basic programming skills (in Python), algorithm design, basics of probability & statistics

INDUSTRIES APPLICABLE TO : Data science companies and many other industries value machine learning skills.

COURSE OUTLINE :

This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. We will cover the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbour, an introduction to Bayesian learning and the naïve Bayes algorithm, support vector machines and kernels and neural networks with an introduction to Deep Learning. We will also cover the basic clustering algorithms. Feature reduction methods will also be discussed. We will introduce the basics of computational learning theory. In the course we will discuss various issues related to the application of machine learning algorithms. We will discuss hypothesis space, overfitting, bias and variance, tradeoffs between representational power and learnability, evaluation strategies and cross-validation. The course will be accompanied by hands-on problem solving with programming in Python and some tutorial sessions.

ABOUT INSTRUCTOR :

Prof. Sudeshna Sarkar is a Professor and currently the Head of the Department of Computer Science and Engineering at IIT Kharagpur. She completed her B.Tech. in 1989 from IIT Kharagpur, MS from University of California, Berkeley, and PhD from IIT Kharagpur in 1995. She served briefly as faculty at IIT Guwahati and at IIT Kanpur before joining IIT Kharagpur in 1998. Her research interests are in Machine Learning, Natural Language Processing, Data and Text Mining.

COURSE PLAN :

Week 01 : Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

Week 02 : Linear regression, Decision trees, overfitting.

Week 03 : Instance based learning, Feature reduction, Collaborative filtering based recommendation.

Week 04 : Probability and Bayes learning

Week 05 : Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Week 06 : Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

Week 07 : Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

Week 08 : Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.



INTRODUCTION TO MULTIMODAL URBAN TRANSPORTATION SYSTEMS (MUTS)

PROF. ARKOPAL KISHORE GOSWAMI

Department of RCG School of Infrastructure Design Management
IIT Kharagpur

INTENDED AUDIENCE : UG Civil Engineering, PG Civil Engineering (Transportation), UG Urban Planning, PG Urban Planning

INDUSTRY SUPPORT: Urban Local Bodies, Transport Network Companies (TNCs), Public transportation operating companies and administrators

COURSE OUTLINE :

This course is refined version of the Post-Graduate course (ID6004) "Planning, Operation and Management of Transportation Facilities" which is being currently taught to the students of Infrastructure Design and Management at IIT Kharagpur. The course's primary objectives are to:

1. Identify the sustainability principles in transportation
2. Introduce the concept of Travel Demand Management (TDM)
3. Disseminate the techniques of urban public transit planning, operations and management
4. Imbibe the concepts of non-motorized urban transport
5. Demonstrate the applications in intelligent transportation systems (ITS)

ABOUT INSTRUCTOR :

Prof. Arkopal K. Goswami is currently a faculty member in the Ranbir and Chitra Gupta School of Infrastructure Design and Management, IIT Kharagpur, where he specializes in Transportation Infrastructure. He earned his Bachelor's in Civil Engineering from NIT Jamshedpur, after which he was awarded a full academic scholarship, along with a research assistantship (RA), to pursue his high studies from the University of Virginia (UVa). He graduated with a Doctorate in Civil Engineering from UVa in the year 2008, under the tutelage of Professor (Emeritus) Dr. Lester A. Hoel. Dr. Goswami specializes in the field of sustainable urban transport, having over 13 years of experience in consulting, public sector, and academia, both in India and United States of America (USA). He is currently a Principal Investigator (PI) of multiple projects that aim to enhance urban transport sustainability in India. To further the cause, Dr. Goswami is collaborating with researchers from around the globe, including Japan, Germany, United Kingdom (UK), and USA. His work has been recognized worldwide, where he has received the Jack H. Dillard best research paper award, and has published in reputed peer reviewed journals including the ASCE Journal of Transportation Engineering, Transport Reviews, and Energy. He has also presented his work at national and international conferences, including the Annual Conference of the Transportation Research Board (TRB), and the World Conference on Transport Research Society (WCTRS). He is a member of the Transportation Research Group (TRG), India; and Eastern Asian Society for Transportation Studies (EASTS). He is currently leading a group of researchers that include 7 PhD students, 8 Masters' students, as well as multiple project personnel. Arkopal loves travelling and is an avid sports enthusiast, where he follows cricket, tennis and basketball.

COURSE PLAN :

Week 1:

Module 1: Overview of urban transportation

- Lec. 1: Urbanization and Transport(0.5 hr.)
- Lec. 2: Key issues in urban transportation (0.5 hr.)
- Lec. 3: Challenges in urban transportation(0.5 hr.)
- Lec. 4: Travel demand modelling overview (0.5 hr.)
- Lec. 5: Vehicular Level of Service (LOS) overview (0.5 hr.)

Week 2:

Module 2: Public Transportation

- Lec. 6: Introduction to public transportation (0.5 hr.)
- Lec. 7: Basic operating elements of public transportation (0.5 hr.)
- Lec. 8: Basic operating elements of public transportation (contd.) (0.5 hr.)
- Lec. 9: Bus Transportation (0.5 hr.)
- Lec. 10: Bus Transportation (contd.) (0.5 hr.)

Week 3:

Module 2: Public Transportation

- Lec. 11: Financing public transportation (0.5 hr.)
- Lec. 12: Transit marketing (0.5 hr.)
- Lec. 13: Rail transportation (0.5 hr.)
- Lec. 14: Intermediate Public Transportation (0.5 hr.)
- Lec. 15: Measuring performance of transit systems (0.5 hr.)

Week 4:

Module 2: Public Transportation

- Lec. 16: Advanced operation concepts of public transportation (0.5 hr.)
- Lec. 17: Bus & Rail Transit Capacity (0.5 hr.)
- Lec. 18: Bus & Rail Transit Capacity (contd.) (0.5 hr.)
- Lec. 19: Station Capacity (0.5 hr.)
- Lec. 20: Transit Stop Location (0.5 hr.)

Week 5:

Module 3: Non-Motorised Transportation (NMT) Planning

- Lec. 21: Introduction to NMT Systems (0.5 hr.)
- Lec. 22: Assessing existing NMT scenario (0.5 hr.)
- Lec. 23: Data collection and analysis in NMT Planning (0.5 hr.)
- Lec. 24: Complementarity and Selection of Interventions (0.5 hr.)
- Lec. 25: Alternative Selection through Economic & Financial Analysis (0.5 hr.)

Week 6:

Module 3: Non-Motorised Transportation (NMT) Planning

- Lec. 26: Introduction to NMT systems (0.5 hr.)
- Lec. 27: Basic NMT Characteristics (0.5 hr.)
- Lec. 28: Pedestrian Data Collection and Flow Characteristics (0.5 hr.)
- Lec. 29: PTS Case Studies Pedestrian flow characteristics on facilities (0.5 hr.)
- Lec. 30: Pedestrian Level of Service (PLOS) based on Flow models (0.5 hr.)

Week 7:

Module 3: Non-Motorised Transportation (NMT) Planning

- Lec. 31: Other types of Pedestrian Level of Service (PLOS) (0.5 hr.)
- Lec. 32: HCM 2010 Methodology for PLOS (0.5 hr.)
- Lec. 33: HCM 2010 Methodology for PLOS (contd.) (0.5 hr.)
- Lec. 34: Bicycle Facilities and Level of Service (BLOS) (0.5 hr.)
- Lec. 35: BLOS and Bicycle Compatibility Index (BCI) (0.5 hr.)

Week 8:

Module 3: Non-Motorised Transportation (NMT) Planning

- Lec. 36: NMT Design Principles (0.5 hr.)
- Lec. 37: Design of Pedestrian Infrastructure (0.5 hr.)
- Lec. 38: Design of Pedestrian Infrastructure (contd.) (0.5 hr.)
- Lec. 39: Design of Cycling Infrastructure (0.5 hr.)
- Lec. 40: Design of Cycling Infrastructure (contd.) (0.5 hr.)

Week 9:

Module 4: Urban Transport & Sustainability

- Lec. 41: Travel Demand Management (TDM) overview (0.5 hr.)
- Lec. 42: Push measures cases (0.5 hr.)
- Lec. 43: Pull measure cases (0.5 hr.)
- Lec. 44: Parking Studies (0.5 hr.)
- Lec. 45: Transit Oriented Development (TOD) (0.5 hr.)

Week 10:

Module 4: Urban Transport & Sustainability

- Lec. 46: Introduction to Intelligent Transportation Systems (ITS) (0.5 hr.)
- Lec. 47: ITS components, applications and communication (0.5 hr.)
- Lec. 48: ITS Architecture (0.5 hr.)
- Lec. 49: Electronic Toll Collection (ETC) (0.5 hr.)
- Lec. 50: Public Bicycle Sharing (PBS) System with ITS (0.5 hr.)

Week 11:

Module 4: Urban Transport & Sustainability

- Lec. 51: Multimodal transportation (MMT) environment (0.5 hr.)
- Lec. 52: Multimodal Level of Service (MMLOS) (0.5 hr.)
- Lec. 53: Multimodal Level of Service (MMLOS) (contd.) (0.5 hr.)
- Lec. 54: Design of multimodal transfer facilities (0.5 hr.)
- Lec. 55: Park & Ride (P&R) Facility Planning (0.5 hr.)

Week 12:

Module 4: Urban Transport & Sustainability

- Lec. 56: An Introduction to Pedestrian Road Safety and associated Risk Factors (0.5 hr.)
- Lec. 57: Road crash estimation and elements of predictive methods (0.5 hr.)
- Lec. 58: Predicting Vehicle-Pedestrian and Vehicle-Bicycle conflicts (0.5 hr.)
- Lec. 59: Environmental Concerns of Urban Transport (0.5 hr.)
- Lec. 60: Sustainable strategies for Urban Transportation (0.5 hr.)



INTRODUCTION TO PSYCHOLOGY

PROF. BRAJ BHUSHAN

Department of Humanities and Social Sciences

IIT Kanpur

INTENDED AUDIENCE : Elective UG, BE, BSc

INDUSTRIES APPLICABLE TO : HR section the companies

COURSE OUTLINE :

This course is designed for better understanding of the self and others. It will help you understand the how and why of thinking, feeling, and action. This introductory psychology course will cover the major psychological constructs and principles, primarily focusing on the perceptual processes, learning, memory, emotions, genetic and environmental determinants of behavior and personality. In the last week it will also demonstrate some lab sessions whereby the relevant construct and phenomena can be empirically tested.

ABOUT INSTRUCTOR :

Prof. Braj Bhushan is a professor of psychology at IIT Kanpur.

COURSE PLAN :

Week 1: Why Psychology? Major milestones in psychology, Major areas of psychology, Major methods used in psychology, Redefining boundaries of the discipline

Week 2: Perception

Week 3: Learning

Week 4: Memory

Week 5: Emotion

Week 6: Genetic and Environmental bases of behaviour

Week 7: Personality

Week 8: Lab session: Perception



KINEMATICS OF MECHANISMS AND MACHINES

PROF. ANIRVAN DASGUPTA

Department of Mechanical Engineering
IIT Kharagpur

PRE-REQUISITES : Engineering Mechanics, Undergraduate Mathematics

INTENDED AUDIENCE : Mechanical, Electrical, Aerospace and Bio-Medical Engineering students

INDUSTRIES APPLICABLE TO : Automobile and Aerospace industries, Automation and robotic device manufacturers, Bio-Medical device manufacturers

COURSE OUTLINE :

This course will deal with kinematic analysis of mechanisms and machines. It will include motion and force transmission analysis of linkage mechanisms, open and closed-chain planar robots, and geared transmission. The discussion will start with an introduction to the subject matter and nomenclature, and will cover direct and inverse kinematics, velocity and acceleration analysis, kinematic path generation for robots, singularities in kinematic chains, principle of virtual work and force analysis, and kinematic analysis of gear transmission. The course will demonstrate various concepts by working out problems relevant to real life applications of mechanisms. The course is expected to help students in their basic understanding and use of kinematic analysis.

ABOUT INSTRUCTOR :

Prof. Anirvan DasGupta is a faculty in Mechanical Engineering at IIT Kharagpur since 1999. His interests are in the mechanics of discrete and continuous systems. He has extensively taught courses at undergraduate and postgraduate levels like Mechanics, Kinematics of Machines, Dynamics, Dynamics of Machines, Vibration Analysis, Wave Propagation in Continuous Media, and Rail Vehicle Dynamics.

COURSE PLAN :

Week 1 : Introduction to Mechanisms (1.5 hr), Mobility Analysis (1.5 hr)

Week 2 : Mobility Analysis (1.5 hr), Displacement Analysis (1 hr)

Week 3 : Displacement Analysis (2.5 hr)

Week 4 : Velocity Analysis (2.5 hr)

Week 5 : Velocity Analysis (2.5 hr)

Week 6 : Velocity Analysis (1.0 hr), Acceleration Analysis (1.5 hr)

Week 7 : Force Analysis (1.5 hr), Introduction to geared transmission (1.0 hr)

Week 8 : Analysis of gear trains (2.0 hr).



MECHATRONICS

PROF. PUSHPARAJ MANI PATHAK

Department of Mechanical Engineering

IIT Roorkee

INTENDED AUDIENCE : Mechanical/Electrical/Electronic under graduate and post graduate students

INDUSTRIES APPLICABLE TO : Automobile, DRDO, Railways

COURSE OUTLINE :

The word mechatronics is composed of "mecha" from mechanism and the "tronics" from electronics. It is the synergistic integration of mechanical engineering, with electronics and intelligent computer control in the design and manufacturing of industrial products and processes. Mechatronics generally involves (i) implementing electronics control in a mechanical system (ii) enhancing existing mechanical design with intelligent control and (iii) replacing mechanical component with an electronic solution. This course will cover all aspects related with mechatronics such as sensors and transducers, actuators and mechanisms, signal conditioning, microprocessors and microcontrollers, modeling & system response and design and mechatronics.

ABOUT INSTRUCTOR :

Prof. Pushparaj Mani Pathak is currently a Professor at IIT Roorkee. He was graduated from N.I.T., Calicut in 1988 in Mechanical Engineering. He completed his M. Tech in Solid Mechanics and Design from IIT Kanpur in 1998. Later he was awarded the PhD degree from IIT Kharagpur in 2005. His areas of research are Robotics, Dynamics, Control, and Bond Graph Modelling. He has served in different industries from 1989 to 1994. He is in teaching profession since 1994. He is serving in Mechanical and Industrial Engineering Department, IIT Roorkee since 2006. He has co-authored one book on Intelligent Mechatronic Systems: Modeling, Control and Diagnosis published by Springer, London and has published more than 40 papers in International Journals in the field of Robotics and Control. He has supervised 34 M. Tech theses and 7 PhD theses in different areas.

COURSE PLAN :

Week 1: Introduction to mechatronics : Introduction, Examples of Mechatronic systems, Electric circuits and components, Semiconductor Electronics, Transistor Applications

Week 2: Electric Circuits and Semiconductor Electronics : Performance terminology of sensors, Displacement, Position & Proximity Sensors-I, Displacement, Position & Proximity Sensors-II, Force, Fluid pressure, Liquid flow sensors, temperature, light sensor, Acceleration and Vibration measurement, Semiconductor sensor and MEM, SAW

Week 3: Sensors and transducers : Mechanical Actuation System, Hydraulic & Pneumatic Actuation System, Electrical Actuation System-I, Electrical Actuation System-II, Data Presentation system

Week 4: Actuators and mechanisms: Introduction to signal processing & Op-Amp, Op-Amp as signal conditioner, Analogue to Digital Converter, Digital to Analogue Converter, Artificial intelligence

Week 5: Signal conditioning: Digital circuits-I, Digital circuits-II, Microprocessor Micro Controller, Programming of Microcontrollers

Week 6: Microprocessors and microcontrollers: Mechanical system model, Electrical system model, Fluid system model, Dynamic response of systems, Transfer function and frequency response.

Week 7: Modeling and system response: P,I, PID Controllers, Digital Controllers, Program Logic Controllers, Input/output & Communication systems, Fault findings

Week 8: Design and mechatronics: Project using Microcontroller-Atmega 16, Myoelectrically Controlled, Robotic Arm, Robocon-Part I, Robocon-Part II, Design of a Legged Robot



MODELLING AND ANALYTICS FOR SUPPLY CHAIN MANAGEMENT

PROF. KUNAL KANTI GHOSH

Department of Management
IIT Kharagpur

PROF. ANUPAM GHOSH

Department of Management
IIT Kharagpur

INTENDED AUDIENCE : Students from Management, Industrial and Systems Engineering, Mechanical Engineering, and related disciplines.

INDUSTRIES APPLICABLE TO : Tata Group of Industries, Multinationals, L&T, and similar manufacturing and service organizations including IT companies

COURSE OUTLINE :

This course focuses on the application of analytical techniques for determining effective solutions to problems associated with supply networks considering the constraints of demand and supply. The objectives of the course are to understand the nature of supply networks, goal of supply networks and explain the impact of analytics based supply chain decisions on the success of a firm. The coverage includes key metrics that track the performance of the supply network in terms of each driver, identification of the key factors to be considered when designing a distribution network and use of analytical techniques for developing a framework for network design. Emphasis is laid on the use of optimization techniques for facility location, capacity allocation and evaluation of supply chain design decisions under uncertainty. Along with these objectives, this course is also aimed at understanding the concepts of multi-criterion decision making in supplier selection and rating, inventory management techniques under uncertain demand and supply environment, mathematical models for design of transportation networks, and the role of soft computing techniques for matching supply with demand.

ABOUT INSTRUCTOR :

Prof. Kunal Kanti Ghosh has over three decades of experience at various levels in the automobile industry. He was the "Corporate Initiatives Head" of Tata Technologies Ltd and was adjudged the "Best Young Materials Manager" by the Indian Institute of Materials Management in 1986. He also received the "Best young Manager's Award" from All India Management Association in 1990. He was the prime architect of "Parts Supply Management System" for Nissan Plant in Australia, Melbourne. He was the project manager in charge of installation and commissioning of semi-automated (Kurimoto Presses) in Jamshedpur plant of Tata Motors in 1988. He holds B Tech (Mechanical Engineering), M Tech (IE & OR), and PhD (Automotive Design). He is a fellow member of the Institution of Engineers (India).

Prof. Anupam Ghosh obtained Masters Degrees with specializations in Supply Chain Management, Accounting, and Commerce. His PhD is on Information Visibility in Supply Chain. He has about 13 years of teaching experience in Supply Chain Management, Supply Chain Analytics, and International Marketing. He was a Visiting Scholar to Bentley University, Waltham, MA, USA during 2004-05. He has worked on projects on Healthcare Information Systems in USA, Fixing Transportation Fares for Public Transportation Systems in India, and has conducted various Management Development Programs on Supply Chain Management and Materials Management.

COURSE PLAN:

Week 1 : Introduction to Modeling and Analytics in Supply Networks:

Introduction to Supply Network, Performance Measures for Efficiency and Effectiveness, SCOR model, Strategic Fit and Scope, Types of Distribution Networks, Analytics in Management, Design of Distribution Networks

Week 2 : Supplier Selection Analytics:

Linear Programming, Rating method, Ranking method, Borda Count, Clustering, Goal Programming and related multi-criterion decision making (MCDM) techniques

Week 3 : Transportation Modeling and Analytics:

Transportation models, Route planning, Transshipment, Shipment schedule, Flow path optimization.

Week 4 : Warehousing Modeling and Analytics:

Warehouse location problem, MILP formulation, Location with foreign exchange risks, space calculation for warehouse, Non-linear optimization for warehouse space allocation

Week 5 : Strategic Performance Improvement:

Data Envelopment Analysis for competitive comparisons among multiple warehouses and service units and formulation of strategic action plans for improving the efficiencies of non-performing DMUs, Stochastic Frontier Analysis.

Week 6 : Inventory Analytics - I:

Elementary Concepts related to Inventory Management, Economic Order Quantity (Instantaneous Replenishment), Economic Production Lot Size, Inventory Model with Planned Shortages (Back-Orders), Inventory Management under Uncertainty – Concept of Safety Stock, Continuous Review System, Periodic Review System

Week 7 : Inventory Analytics - II:

Newsvendor Model, Performance Measures: Expected Lost Sales, Expected Sales, Expected Leftover Inventory, Expected Profit, Fill Rate, In-Stock Probability, and Stock-Out Probability

Week 8 : Inventory Analytics - III:

Choosing an Order-up-to Level to Meet a Target Service Level, In-Stock Probability, and Desired Fill-Rate

Week 9 : Inventory Analytics - IV:

Assemble-to-Order, Make-to-Order and Quick Response with Reactive Capacity, Reducing Mismatch Costs with Make-To-Order

Week 10 : Modeling Coordination in Supply Chains:

Information Distortion in Supply Network and Bull-Whip Effect, Coordination and collaboration modeling in supply networks.

Week 11 : Risk Analytics in Supply Network Design:

Mapping the riskiness profile of a country, taxation, Mapping the riskiness profile of possible international routes and Designing the route plan based on riskiness profile

Week 12 : Design and Modeling the global supply chain:

Design and optimization of global supply chain networks, Multi-period supply chain network design



MUNICIPAL SOLID WASTE MANAGEMENT

PROF. AJAY KALAMDHAD

Department of Civil Engineering
IIT Guwahati

INTENDED AUDIENCE : PG Level course for Environmental Engineering and UG level for Civil Engineering

INDUSTRY SUPPORT : Synergy waste management Pvt Ltd, UPL Environmental Engineers Pvt Ltd, Green power systems, A2Z group, Timarpu-Okhla waste management pvt ltd, Ramky Enviro Engineers Limited

COURSE OUTLINE :

The problems affiliated with solid waste management (SWM) in today's sprawling civilized and urbanized society are intricate because of the quantity and varied nature of wastes, the funding restriction for public disposal, interference of technology (energy and raw materials), and complex infrastructure development network in urban cities. As a result, if SWM is to achieve in consummate approach, the fundamentals aspects need to be identified. Thus, there is dire need to group the activities from the generation to the disposal point. The six different functional elements (generation, handling and separations, storage and processing at source, collection, the transformation of wastes, transfer and transport, and final disposal) for the engineering comparison and treatment need to be understood in detail. The understanding of the functional element is important because it helps in evaluating the impacts of projected changes and technological developments. Solid waste management is an essential part of every society, but it is also one of the most neglected one. An in-depth understanding of the subject is required to tackle the current solid waste management crisis effectively. This course attempts to familiarize various steps involved in solid waste management.

ABOUT INSTRUCTOR :

Prof. Ajay Kalamdhad is a Professor in the Department of Civil Engineering, Indian Institute of Technology Guwahati. He received his PhD from Indian Institute of Technology Roorkee in the year of 2008 and started working as a Lecturer in Visvesvaraya National Institute of Technology from September 2008. He joined Indian Institute of Technology Guwahati in June 2009 as an Assistant Professor. His research interests include Solid waste management, Mechanical composting and vermicomposting, Anaerobic digestion, Analysis of solid wastes, Microbiology of composting, Biosorption and Water & Wastewater Treatment. He has published numerous papers in various reputed journals. He is also the head of Waste Management Research Group (WMRG), a group that focuses on the biological treatment of various wastes.

COURSE PLAN :

Week 1: Evolution of Solid Waste Management

Week 2: Sources/Types and Characteristics of Solid Waste

Week 3: Generation of Solid Waste

Week 4: Waste Handling, Separation, storage, and Processing

Week 5: Collection of Solid Waste

Week 6: Transfer and Transport

Week 7: Separation and processing of Solid Waste

Week 8: Chemical Transformation (combustion/incineration)

Week 9: Biological Treatment (Composting)

Week 10: Biological Treatment (Anaerobic Digestion)

Week 11: Disposal of Solid Waste

Week 12: ISWM and legislation



NATURAL LANGUAGE PROCESSING

PROF. PAWAN GOYAL

Department of Computer Science and Engineering

IIT Kharagpur

PRE-REQUISITES : Basic knowledge of probabilities for the lectures and python for programming assignment

INDUSTRIES APPLICABLE TO : Microsoft Research, Google, Adobe, Xerox, Flipkart, Amazon

COURSE OUTLINE :

This course starts with the basics of text processing including basic pre-processing, spelling correction, language modeling, Part-of-Speech tagging, Constituency and Dependency Parsing, Lexical Semantics, distributional Semantics and topic models. Finally, the course also covers some of the most interesting applications of text mining such as entity linking, relation extraction, text summarization, text classification, sentiment analysis and opinion mining.

ABOUT INSTRUCTOR :

Prof. Pawan Goyal is an Assistant Professor at the Department of Computer Science and Engineering, IIT Kharagpur. His research interests include Natural Language Processing, Text Mining, Information Retrieval and Sanskrit Computational Linguistics. He has published around 75 research papers in international conferences and journals. He has published in various top-tier conferences and journals including ACL, NAACL, EMNLP, SIGIR, KDD, CIKM, JCDL, ICWSM, CSCW, Coling, IEEE and ACM transactions. Prior to joining IIT Kharagpur, he received his B. Tech. degree in Electrical Engineering from IIT Kanpur in 2007 and his Ph.D. degree in the faculty of Computing and Engineering from University of Ulster, UK in 2011. He was then a Post Doctoral Fellow at INRIA Paris Rocquencourt.

COURSE PLAN :

Week 1: Introduction and Basic Text Processing

Week 2: Spelling Correction, Language Modeling

Week 3: Advanced smoothing for language modeling, POS tagging

Week 4: Models for Sequential tagging – MaxEnt, CRF

Week 5: Syntax – Constituency Parsing

Week 6: Dependency Parsing

Week 7: Distributional Semantics

Week 8: Lexical Semantics

Week 9: Topic Models

Week 10: Entity Linking, Information Extraction

Week 11: Text Summarization, Text Classification

Week 12: Sentiment Analysis and Opinion Mining



NATURE AND PROPERTIES OF MATERIALS

PROF. BISAKH BHATTACHARYA

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : Basic Physics and Mathematics Courses at the First Year Level, added with thirst for learning.

INTENDED AUDIENCE : Students of BE/B.Tech stream

INDUSTRIES APPLICABLE TO : Every industry recommends to have a basic knowledge about various materials and truth behind their properties

COURSE OUTLINE :

This course introduces to the basics of metals and metallic alloys, polymers, composites and smart materials which have extensively broadened the scope of engineering design in the fields of Civil, Mechanical, Aerospace and other structural applications. After learning this course, students will be well-versed with the underlying principle governing the material properties and should be able to select proper material for their application.

ABOUT INSTRUCTOR :

Prof. Bishakh Bhattacharya is Professor at the Department of Mechanical Engineering and currently heading the Cognitive Science programme, IIT Kanpur. His research interest primarily lies in vibration control, structural health monitoring, energy harvesting system, intelligent system design and Child-Reconfigurable Robot Interaction.

COURSE PLAN :

Week 1: Introduction to Engineering materials & Mechanical properties

Week 2: Atomic bonding and crystal structure

Week 3: Metals and Ceramics

Week 4: Polymers

Week 5: Composite Materials

Week 6: Smart Materials

Week 7: Materials selection in Engineering design

Week 8: Non-mechanical properties and Laboratory demonstration



NON-CONVENTIONAL ENERGY RESOURCES

PROF. PRATHAP HARIDOSS

Department of Multidisciplinary
IIT Madras

PRE-REQUISITES : Course will be accessible to most students who have completed their first two years of study at an Undergraduate level.

INTENDED AUDIENCE : Interested students

COURSE OUTLINE :

This course looks at the operating principle of a range of non-conventional energy resources, materials used, characterization, and key performance characteristics. The technologies looked at will include, Solar energy, Wind, Batteries, Fuel cells, and Geothermal conversion. The advantages and limitations of these technologies in comparison to conventional sources of energy will also be examined.

ABOUT INSTRUCTOR :

Prof. Prathap Haridoss is a Professor in the Department of Metallurgical and Materials Engineering at IIT Madras. He works in the areas of Fuel Cell and Carbon nanomaterials. He has a B.Tech in Metallurgical Engineering from IIT Madras, and a PhD in Materials Science and Engineering from the University of Wisconsin-Madison, USA. Before he joined as a faculty at IIT Madras, he served as a Senior Scientist at Plug Power, a Fuel Cell company in New York. He has 3 US patents, several International Journal publications, and has published a book titled "Physics of Materials, Essential Concepts of Solid State Physics".

COURSE PLAN :

Week 1: Scale of quantities, Impact of current energy usage, Conventional sources of energy

Week 2: Overview of non-conventional energy resources, Consumption by sector

Week 3: Solar energy incident on earth, solar spectrum

Week 4: Overview of solar energy technologies, Solar Thermal devices

Week 5: Solar Photo-voltaic devices, Performance and durability of solar devices

Week 6: Wind energy, technology and geographical aspects

Week 7: Geothermal and Biomass

Week 8: Battery basics, types

Week 9: Testing, performance of batteries

Week 10: Fuel cell types, Fuel processing, concept to product.

Week 11: Characterization and durability of fuel cells

Week 12: Flywheels and super capacitors



PHOTOGEOLOGY IN TERRAIN EVALUATION (PART – 1 & 2)

PROF. JAVED N. MALIK

Department of Civil Engineering
IIT Kanpur

TYPE OF COURSE : Rerun | Elective | UG

COURSE DURATION : 8 weeks (26 Jul'21 - 17 Sep'21)

EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Any Interested Learners

COURSE OUTLINE :

The course introduces the student to a globally applied tool known as Photogeology or Geo-photography; a technique first structured by the United States in late 19th century and later incorporated in United State Geological Survey. The weekly modules will demonstrate the concept and principles of Photogeology and its applications in real life. Students will learn reading the aerial and satellite photographs under the stereoscope and to generate a 3D view of the terrain. Using this tool they will be able to extract all types of information of the earth surface for various engineering and scientific purpose and projects. Students will have wonderful experience of aerial view of the earth surface and will extract information of landforms, sub-surface structures, and rock types etc. to perform terrain evaluation.

ABOUT INSTRUCTOR :

Prof. Javed Malik earned his Ph.D in 1998 from M.S. University Baroda, Vadodara, Gujarat (Geology), and did Post-Doctorate (Japan Society for Promotion of Science) from (1999-2001) Hiroshima University, JAPAN.

* He Joined IIT Kanpur in 2001.

* Areas of Specialization are : Active Tectonics, Paleoseismology and Paleo-tsunami

COURSE PLAN :

- Week 01** : Introduction to Photogeology and its Applications, Aerial Photography/ Satellite Imaging and their Applications, Aerial/ Satellite Photographs and Exercise on handling photographs, Principles of Stereoscopy and Exercise on creating 3D image using Stereoscope
- Week 02** : Photogrammetry – Exercise on Elements of Photo Interpretation and Line of Flight, Photogrammetry – Exercise on Photographic Measurements and Photo Scale, Role of Vertical Exaggeration in Photogrammetry - Related Lab Exercise,
- Week 03** : Introduction to Lithology Sedimentary Rocks, Introduction to Lithology Metamorphic Rocks, Introduction to Lithology Igneous Rocks, Related Exercise, Introduction to Physical and Structural geology, Introduction to Physical and Structural geology
- Week 04** : Introduction to Physical and Structural geology Related Exercise on Identification of structures, Fluvial Geomorphology Exercise on Landform Mapping, Fluvial Geomorphology Exercise on Terrace Mapping, Morphometric Analysis Exercise on performing Morphometric Analysis, Generation of Anaglyph using Stereo-pair in ENVI software Lab Exercise
- Week 05** : Introduction to Physical and Structural, geology, Introduction to Physical and Structural geology - Related Exercise on Identification of structures, Introduction to Lithology, Sedimentary Rocks
- Week 06** : Introduction to Lithology, Sedimentary Rocks, Metamorphic, Rocks, Igneous Rocks
- Week 07** : Fluvial Geomorphology Exercise on, Landform Mapping, Coastal and Aeolian Landforms, Active Tectonics and Geomorphology
- Week 08** : Active Tectonics and Geomorphology, Morphometric Analysis – Exercise on performing Morphometric Analysis, Photogeology in Lithological Mapping



PROBLEM SOLVING THROUGH PROGRAMMING IN C

PROF. ANUPAM BASU

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : BE/BTech in all disciplines BCA/MCA/M. Sc

INDUSTRIES APPLICABLE TO : All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Use arrays, pointers and structures to formulate algorithms and programs
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration

ABOUT INSTRUCTOR :

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing. Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN :

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching

Week 3: Conditional Branching and Iterative Loops

Week 4: Arranging things : Arrays

Week 5: 2-D arrays, Character Arrays and Strings

Week 6: Basic Algorithms including Numerical Algorithms

Week 7: Functions and Parameter Passing by Value

Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

Week 10: Structures and Pointers

Week 11: Self-Referential Structures and Introduction to Lists

Week 12: Advanced Topics



PRODUCT DESIGN AND DEVELOPMENT

PROF. INDERDEEP SINGH

Department of Mechanical and Industrial Engineering
IIT Roorkee

PRE - REQUISITES : Any student enrolled for a UG/PG degree in any discipline of humanities, management, science and engineering can complete the course.

INDUSTRY SUPPORT : All industries where products are being conceptualized, designed and developed in order to satisfy the human needs and requirements.

INTENDED AUDIENCE: It is a core course for UG and PG

COURSE OUTLINE :

It has been established worldwide that the most successful economies are based on innovation and creativity led entrepreneurship. The government is focusing on putting concerted efforts to produce job creators. The current MOOC on Product Design and Development is conceptualized and planned in such a way that it helps both job creators as well as job seekers. The main objective of the course is to acquaint the learners/students with the practical knowledge regarding conceptualization, design and development of a new product. The need of a new product, the product life cycle, the product design process, the application of Value Engineering principles in product design, various product design tools such as CAD, DFM, DFA and DFMA have been explained with relevant and specific examples/ case studies. The concept of Ergonomics in context of the product design has been explained with the help of case studies. The fundamental concept of Rapid Prototyping as well the working principles of the basic rapid prototyping techniques has also been explained.

ABOUT INSTRUCTOR :

Prof. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed three video and one web course under the National Programme on Technology Enhanced Learning (NPTEL). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

COURSE PLAN :

Week1: Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.

Week 2: Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

Week 3: Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design,.

Week 4: DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS



PRODUCT DESIGN AND MANUFACTURING

PROF. J. RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Innovation, better management, throughput improvements, and expansion of new technologies have led Product Design and Manufacturing as a compelling field for the students. Managing the product development process, right from idea generation to final product manufacturing has to be systematic and effective to meet the customer needs, while incorporating the time-to-market constraint as well. This course presents an overview of the product design and development process, along with the manufacturing systems aspects. The concepts Design for Manufacturing, Assembly, and Environment, and analytical tools for development, costing and manufacturing would help the students and practitioners learn to conceptualize, design, and manufacture competitively-priced quality products. Reverse Engineering, Prototyping and Simulation using soft tools are also incorporated make the students learn the advanced methods in manufacturing.

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers

Prof. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1: Introduction to product design and manufacturing

Week 2: Product design morphology

Week 3: Visual Design, and Quality Function Deployment (QFD)

Week 4: Value Engineering

Week 5: Material, and Manufacturing process selection

Week 6: Design for Manufacturing, Assembly, and Maintenance

Week 7: Design for Environment, and Quality Control

Week 8: Patenting, and Creativity

Week 9: Rapid Prototyping

Week 10: Plant Layout Design

Week 11: Computer Integrated Manufacturing

Week 12: Reverse Engineering, and Managing Competitiveness



PRODUCTION AND OPERATION MANAGEMENT

PROF. RAJAT AGRAWAL

Department of Management
IIT Roorkee

INTENDED AUDIENCE : Management & Science students

INDUSTRIES APPLICABLE TO : BHEL, THDC, Hero Motocorp, UJVNL, Maruti, etc.

COURSE OUTLINE :

Production and operations Management will introduce students to the many operations topics and issues faced by leading organizations, both in service and in manufacturing. The goal of this course is to help students gain an understanding of what operations management involves, how it relates to other functional areas in an organization, the types of problems that are faced by operations managers, and common decision-making approaches.

ABOUT INSTRUCTOR :

Prof. Rajat Agrawal is a member of faculty (Associate Professor) at Department of Management Studies, Indian Institute of Technology Roorkee. He is also associate faculty member at Center of Excellence for Disaster Mitigation and Management and Center of Excellence for Transportation Management, IIT Roorkee. He administers various initiatives of IIT Roorkee in the field of IPR, incubation and entrepreneurship in different capacities. He initiated the incubation centre at IIT Roorkee. He is cocordinator of Design innovation centre at IIT Roorkee and is also the IPR Chair Coordinator there.

COURSE PLAN :

Week 1: Introduction to Operations Management

Week 2: Introduction to Forecasting

Week 3: Causal Methods of forecasting

Week 4: Various variations of EOQ

Week 5: Aggregate Sales and Operations Planning

Week 6: Nature of Quality

Week 7: Acceptance Sampling

Week 8: Facility Capacity

Week 9: Service Facility Layout

Week 10: Maintenance Management

Week 11: Process Analysis

Week 12: Supply Chain Strategy



PROGRAMMING IN JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

Week 7: Multithreaded Programming

Week 8: Java Applets and Servlets

Week 9: Java Swing and Abstract Windowing Toolkit (AWT)

Week 10: Networking with Java

Week 11: Java Object Database Connectivity (ODBC)

Week 12: Interface and Packages for Software Development



PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE : Students in any branch of mathematics/science/engineering, 1st year

PRE-REQUISITES : School level mathematics.

INDUSTRIES APPLICABLE TO : This course should be of value to any company requiring programming skills.

COURSE OUTLINE :

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

COURSE PLAN:**Week 1:**

Informal introduction to programming, algorithms and data structures

Downloading and installing Python

gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions

Week 2:

Python: types, expressions, strings, lists, tuples

Python memory model: names, mutable and immutable values

List operations: slices etc

Binary search

Inductive function definitions: numerical and structural induction

Elementary inductive sorting: selection and insertion sort

In-place sorting

Week 3:

Basic algorithmic analysis: input size, asymptotic complexity, $O()$ notation

Arrays vs lists

Merge sort

Quicksort

Stable sorting

Week 4:

Dictionaries

More on Python functions: optional arguments, default values

Passing functions as arguments

Higher order functions on lists: map, iter, list comprehension

Week 5:

Exception handling

Basic input/output

Handling files

String processing

Week 6:

Backtracking: N Queens, recording all solutions

Scope in Python: local, global, nonlocal names

Nested functions

Data structures: stack, queue

Heaps

Week 7:

Abstract datatypes

Classes and objects in Python

"Linked" lists: find, insert, delete

Binary search trees: find, insert, delete

Height-balanced binary search trees

Week 8:

Efficient evaluation of recursive definitions: memoization

Dynamic programming: examples

Other programming languages: C and manual memory management

Other programming paradigms: functional programming



PROJECT PLANNING & CONTROL

PROF. KOSHY VARGHESE

Department of Civil Engineering
IIT Madras

INTENDED AUDIENCE : UG/PG/Industry Participants

PRE-REQUISITES : Basic Mathematics with Probability & Statistics

INDUSTRIES APPLICABLE TO : All leading construction companies.

COURSE OUTLINE :

This course will cover the basic concepts in Project Planning and Control with a focus on construction projects. The course is relevant to Civil Engineering senior level undergraduate as well as post-graduate students in the area of construction management. Practicing engineers who are part of the planning team on construction projects will also benefit from the concepts covered in the course.

ABOUT INSTRUCTOR :

Prof. Koshy Varghese is a Professor with the Building Technology & Construction Management Division of Department of Civil Engineering, Indian Institute of Technology Madras (IITM). Prof. Varghese earned his Doctoral Degree at the University of Texas at Austin in 1992 and worked as a Post-Doctoral Fellow for a year after which he joined IIT Madras. Prof. Varghese is a pioneer in construction management education and research in India and He has received numerous academic honors, and he is on the editorial-board of several international journals. He is also a Member of the Board of Directors of ILCE (Institute for Lean Construction Excellence).

COURSE PLAN :

Week 01 : Introduction, Course Context, Construction Project Management

Week 02 : Time Management, Work Breakdown Structure (WBS), Gantt Charts

Week 03 : Duration Estimation, Network Representation & Analysis -1

Week 04 : Network Representation & Analysis -2; Two-Span Bridge: Scheduling, Network Analysis and Application

Week 05 : Time-Cost Trade-off (Crashing)

Week 06 : Resource Scheduling

Week 07 : Precedence Diagramming Method (PDM), Project Monitoring & Control

Week 08 : Project Monitoring & Control (Earned Value Concepts), Uncertainty in Project Schedules (PERT), Course Summary



PSYCHOLOGY OF EVERYDAY

PROF. BRAJ BHUSHAN

Department of Humanities and Social Sciences
IIT Kanpur

PROF. ALOK BAJPAI

Department of Humanities and Social Sciences
IIT Kanpur

PRE-REQUISITES : Pursuing UG/PG in Psychology, Psychiatry, Psychiatric Social Work, Psychiatric Nursing, etc.

INTENDED AUDIENCE : Anyone interested in mental health issues

INDUSTRIES APPLICABLE TO : Institutions offering MA/MSc/MPhil in clinical/ guidance&counseling/ mental health programmes

COURSE OUTLINE :

This course picks-up threads from the basic observed behavior in everyday life and enters into a dialogue facilitating self-reflection and thus better self-understanding. The emphasis is on what a common man observes and how the knowledge of psychology and psychiatry can be applied to it for better clarity.

ABOUT INSTRUCTOR :

Prof. Braj Bhushan is a professor of psychology at IIT Kanpur. His research interest lies in Cognitive Neuropsychology, Cognitive Factors in Design, Trauma Psychology. He has been awarded with many laurels some being "Our Common Future Fellowship (2010), Volkswagen Stiftung, Germany", "Abstract Award (2008), International Association for Suicide Prevention, 3rd Asia Pacific Regional Conference of IASP, Hong Kong", "In Search of Excellence' Award (2004), IAAP and NAOP-I", "Young Scientist Award (2002), Indian Science Congress Association", "B.H.U. Merit and Prize Award (1991), Banaras Hindu University".

Prof. Alok Bajpai has been trained in Psychiatry at National Institute of Mental health and NeuroSciences (NIMHANS) Bangalore. He did his DPM, MD and is currently practicing at Kanpur and is also the Psychiatrist with Counselling cell, IIT Kanpur. His research interest are in Physics of Brain, Sleep and EEG.

COURSE PLAN :**Week 1:**

- Introduction to clinical psychology
- Introduction to psychiatry
- Understanding behaviour- I
- Understanding behaviour- II
- Revisiting normal-abnormal dilemma- I

Week 2:

- Revisiting normal-abnormal dilemma- II
- Revisiting normal-abnormal dilemma- III
- Revisiting normal-abnormal dilemma- IV
- Issues confronting the young adults- I
- Issues confronting the young adults- II

Week 3:

- Issues confronting the young adults- III
- Issues confronting the young adults- IV
- Mental health issues of adults- I
- Mental health issues of adults- II
- Mental health issues of adults- III

Week 4:

- Mental health issues of adults- IV
- Mental health issues of child & adolescents- I
- Mental health issues of child & adolescents - II
- Mental health issues of child & adolescents - III
- Mental health issues of child & adolescents - IV



PYTHON FOR DATA SCIENCE

PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PRE-REQUISITES : Knowledge of basic data science algorithms

INTENDED AUDIENCE : Final Year Undergraduates

COURSE OUTLINE :

The course aims at equipping participants to be able to use python programming for solving data science problems

ABOUT INSTRUCTOR :

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

COURSE PLAN :**Week 1:****BASICS OF PYTHON SPYDER (TOOL)**

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

Week 2:**Sequence data types and associated operations**

- Strings
- Lists
- Arrays
- Tuples
- Dictionary
- Sets
- Range

NumPy

- ndArray

Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

Data visualization on Toyota Corolla dataset using matplotlib and seaborn libraries

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

Control structures using Toyota Corolla dataset

1. if-else family
2. for loop
3. for loop with if break
4. while loop
5. Functions

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income



RAPID MANUFACTURING

PROF. JANAKARAJAN RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH OBEROI

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program

INTENDED AUDIENCE : Students of all Engineering and Science disciplines

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

In the contemporary dynamic manufacturing era, to produce products that can be easily made and can offer typical competences is of utmost importance. Besides basic manufacturing processes, engineering students and manufacturers need to bolster their skills in advanced technologies. This course is a step in this direction to make the students learn design, development, and manufacturing using Rapid Manufacturing technologies. Along with specific Rapid Prototyping techniques, manufacturing concerns such as geometric modelling, design for manufacturing and assembly, developing modular designs, group technology, et cetera are included. Laboratory demonstrations are also induced for practical experience. In the end of this course, students should be able to identify the methods and techniques required to manufacture any model.

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers.

Prof. Amandeep Singh Oberoi is a Faculty for online courses and shoulders the position of Senior Research Establishment Officer at the prestigious Indian Institute of Technology (IIT) Kanpur, India. Under the role, he is entrusted with the responsibility to manage Imagineering Laboratory, where the emphasis is principally given to providing novel product development and fostering services in defense, Agritech, and Medtech. Dr. Oberoi has accumulated an experience of over two decades: industrial and academic combined; his research interests include the things he values such as Sustainable Manufacturing Processes and Systems, along with areas such as Additive Manufacturing; Simulation of Manufacturing Systems; Product Design and Manufacturing. He has fetched grants and has holds projects from various national and international funding agencies such as DST, MoT, BIRAC, DRDO, SIDBI, CoL. His MOOCs courses in NPTEL and agMOOC are well-received, gaining favour with the audience and receiving positive feedback. Furthermore, he has visited countries like the USA, Canada, Australia, and Egypt to speak at various international symposiums organised by renowned bodies such as AARDO, CIRP, IEOM.

COURSE PLAN :

Week 1 : Introduction to Rapid Manufacturing (RM)

Week 2 : Product Design Process

Week 3 : Design for Modularity

Week 4 : Reverse Engineering

Week 5 : 3D measurement: laboratory demonstration

Week 6 : Polymerization, and Powder based RM processes

Week 7 : Liquid based, and Sheet stacking RM processes

Week 8 : 3D printing RM processes and laboratory demonstration

Week 9 : Beam Deposition RM processes, and materials in RM

Week 10 : Post-processing and costing in RM

Week 11 : Rapid Product Development (CAD/CAE/CIM)

Week 12 : Rapid Product Development (Software demonstration), and case studies on RM



RECENT ADVANCES IN TRANSMISSION INSULATOR

PROF. SUBBA REDDY

Department of Electrical Engineering
IISc Bangalore

TYPE OF COURSE : Rerun | Elective | UG/PG

COURSE DURATION : 4 weeks (24 Jan' 22 - 18 Feb' 22)

EXAM DATE : 27 Mar 2022

PRE-REQUISITES : Basic knowledge of Electrical Engineering.

INTENDED AUDIENCE : 3rd or 4th year UG, 1st year masters and research students UG/PG course, industry/utility participants can also register.

COURSE OUTLINE :

This course introduces the recent advances in EHV/UHV transmission Insulators. The course emphasizes learning and understanding the newer design criteria for the UHV transmission insulation. The course starts with an introduction to the importance of EHV /UHV transmission, its present and future growth. The discussion on the various components used for UHV transmission, design considerations etc are strengthened with the aid of lectures, practical video demonstrations and assignment exercises.

ABOUT INSTRUCTOR :

Prof. Subba Reddy B is a Principal Research Scientist at the High Voltage Laboratory, Dept. of Electrical Engineering, Indian Institute of Science, Bangalore, India. He received Bachelor in Electrical Engineering degree from Karnatak university, Dharwad, and MSc(Engg) and PhD from Indian Institute of Science, Bangalore, India.

His research interests are high voltage engineering, transmission line insulators, numerical techniques for high voltage applications, condition monitoring and diagnostics of HV equipment, surge arresters, renewable energy systems etc. He has received national and international recognition for his research work. He is a Fellow of Institution of Engineers (India), Fellow, Society of Power Engineers (India) and Senior member IEEE

COURSE PLAN :

Week 1: Introduction, Important components of transmission system, Insulation coordination

Week 2: Non ceramic insulators performance-service experience, Pollution/contamination flashover phenomena modelling etc , Failures, importance of reliability and testing

Week 3: High Voltage testing and techniques employed, HV testing techniques for Ceramic / Glass Insulators

Week 4: Surface degradation studies on composite insulators , Recent studies on composite insulators \ Summary



REMOTE SENSING AND GIS

PROF. RISHIKESH BHARTI

Department of Civil Engineering
IIT Guwahati

INTENDED AUDIENCE : UG, PG and PhD Students

INDUSTRIES APPLICABLE TO : Esri, Rolta India, RMSI Private Limited, ArcGeosystems

COURSE OUTLINE :

This course will introduce the students to the state-of-the-art concepts and practices of remote sensing and GIS. It starts with the fundamentals of remote sensing and GIS and subsequently advanced methods will be covered. This course is designed to give comprehensive understanding on the application of remote sensing and GIS in solving the research problems. Upon completion, the participants should be able to use remote sensing (Satellite images and Field data) and GIS in their future research work.

ABOUT INSTRUCTOR :

Prof. Rishikesh Bharti is a faculty member at the Department of Civil Engineering, Indian Institute of Technology Guwahati. He has been teaching Advanced Remote Sensing, Geohazard Science and Engineering, Advanced Techniques in Geoscience, Engineering Geology to the B.Tech, M.Tech and PhD students at IIT Guwahati. Hydrogeomorphology, Geospatial modelling, Snow and Glacier Studies, Spectroscopy of natural and man-made materials and Advance remote sensing (Hyperspectral and thermal) for the earth and planetary exploration are his major research interests. He hopes participants will enjoy and learn the proposed course. The details of his research can be found at Website: <http://www.iitg.ac.in/rbharti/>

COURSE PLAN :

Week 1: Remote Sensing Data and Corrections

Week 2: Satellite Image Corrections

Week 3: Digital Image Processing-I

Week 4: Digital Image Processing-II

Week 5: Thermal and Microwave

Week 6: Imaging Spectroscopy-I

Week 7: Imaging Spectroscopy-II & GIS-I

Week 8: GIS-II and Application



ROBOTICS AND CONTROL: THEORY AND PRACTICE

PROF. N. SUKAVANAM

Department of Mathematics
IIT Roorkee

PROF .M. FELIX ORLANDO

Department of Electrical Engineering
IIT Roorkee

PRE-REQUISITES : Basic Mathematics

INTENDED AUDIENCE : Electrical Engineering, Computer Science Engineering, Mechanical Engineering, Electronics and Communication Engineering, Mathematics students

COURSE OUTLINE :

Robotics has stimulated an growing interest among a wide range of scholars, researchers and students due to its interdisciplinary characteristics. The development of this field of science is boosted by various domains which are not limited to Cybernetics, Controls, Computers, Mechanics, Bio-Engineering, and Electronics. Among these areas, modelling, control, planning play a fundamental role not only in the growth of industrial robotics, but also towards the advanced fields including healthcare and field robotics.

Through this course the participants will acquire the ability to conduct research, develop innovative designs in the field of systems engineering and control of robots and to direct the development of engineering solutions in new or unfamiliar environments by linking creativity, innovation and transfer of technology.

ABOUT INSTRUCTOR :

Prof. N. Sukavanam received his Ph. D from the Indian Institute of Science, Bangalore in 1985. He served as a Scientist-B at Naval Science and Technological Laboratory, DRDO for two years (1984-86). Then joined as a Research Scientist in the Department of Mathematics, IIT Bombay (1987-90). Worked as a Lecturer at BITS Pilani from 1990 to 1996. Currently he is a Professor in the Department of Mathematics IIT Roorkee and heads the department.

Prof. M. Felix Orlando received his Ph.D. from Electrical Engineering Department at Indian Institute of Technology Kanpur (IITK) in 2013. In 2015, he completed his post doctoral fellowship at Case Western Reserve University, USA on Medical robotics. Dr. Felix Orlando has been working as an Assistant Professor in the Department of Electrical Engineering at the Indian Institute of Technology Roorkee (IITR) from November 2015 onwards.

COURSE PLAN :

Week 1: Simple manipulators: Two /three arm manipulators and their kinematics equations, Work space Homogeneous Transformation: Rotation, Translation, Composition of homogeneous transformations

Week 2: Denavit-Hartenberg Algorithm: D-H procedure for fixing joint coordinate frames, Robot parameters, Arm matrix, Inverse Kinematics for PUMA, SCARA manipulators.

Week 3: Introduction to Robotic Exoskeletons ,Optimal Design of a Three Finger Exoskeleton for Rehabilitation Purpose

Week 4: Differential transformation and velocity of a frame: Derivative of a frame, Velocity, Jacobian, Inverse Jacobian, Trajectory Planning: Polynomial trajectory, Biped trajectory

Week 5: Dynamics: Lagrangian method, Robot dynamics equation, Control: Robot dynamics equation as a control system, Trajectory tracking control, PD controller, Neural network control design

Week 6: Redundancy Resolution of Human Fingers using Robotic Principles ,Manipulability Analysis of Human Fingers during Coordinated Object Rotation ,Kinematics of Flexible Link Robots

Week 7: Robot Assisted Needling System for Percutaneous Intervention-An Introduction ,Smart Robotic Needles for Percutaneous Cancerous Interventions

Week 8: Robust Force Control of a Two Finger Exoskeleton during Grasping ,Neural Control of an Index Finger Exoskeleton



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Software Testing

By Prof. Meenakshi D'souza | IIIT Bangalore

Learners enrolled: 15572

Software Testing _ Course Introduction



ABOUT THE COURSE :

This course will cover various techniques for test case design, as used for testing of software artifacts including requirements, design and code. We will discuss algorithms and techniques for test case design based on graphs, logic, syntax of programming

Summary

Course Status :	Completed
Course Type :	Elective
Duration :	12 weeks
Category :	Computer Science and Engineering
Credit Points :	3
Level :	Undergraduate/Postgraduate
Start Date :	25 Jul 2022
End Date :	14 Oct 2022
Enrollment	08 Aug 2022
Ends :	
Exam Date :	30 Oct 2022 IST





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INTENDED AUDIENCE: Any Interested Learners

PRE-REQUISITES: Programming, Algorithms, Discrete Mathematics (basics)

(<https://swayam.gov.in/c-details/NPTEL>)

INDUSTRY SUPPORT: The material of this course has been used to offer training for Samsung, ABB and Mindtree. The course will be useful for any firm that does tests their software.

inputs. Special techniques for testing object-oriented features and web

so be discussed. The course will end with a project. **About Swayam** (<https://swayam.gov.in/about>)

cover test cases for both white-box and black-box.

Note: This exam date is subjected to change based

on seat availability. You can check final exam date ()

on your hall ticket.

This is an AICTE approved FDP course

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(https://www.addtoany.com/share?url=https%3A%2F%2Fonlinecourses.nptel.ac.in%2Fnoc22_cs61%2Fpr%20Course)

Course layout

Week 1: Techniques and algorithms for test case design: Graphs based testing- structural coverage criteria.

Week 2: Graphs based testing: Data flow coverage criteria

Week 3: Graphs based testing: Data flow coverage criteria

Week 4: Graphs coverage for source code, design elements and requirements

Week 5: Techniques and algorithms for test case design: Logic based testing-

Predicates, logic based coverage criteria

Week 6: Specification based logic coverage, logic coverage on finite state machines

Week 7: Input space partitioning: Input domain modeling, combination strategies criteria

Week 8: Syntax based testing: Coverage criteria based on syntax, mutation testing

Week 9: Test case design (as learnt above) applied to object-oriented applications

Week 10: Test case design (as learnt above) applied to web applications

Week 11: Symbolic testing

Week 12: Concolic testing, Conclusion





References

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Instructor bio

(https://swayam.gov.in/nc_details/NPTEL)



**Prof. Meenakshi
D'souza**

IIIT Bangalore

Prof. Meenakshi D'souza is currently an Associate Professor at IIIT-Bangalore. Meenakshi did her Master TMs in Mathematics from University of Madras, Chennai and her Ph. D. in Theoretical Computer Science from The Institute of Mathematical Sciences, Chennai. She joined the research department of Honeywell Technology Solutions, Bangalore soon after completing her Ph. D. and worked there in the areas of Formal Verification of Software Design, Model Based Development and Physical Access Control before joining IIIT-Bangalore. Her research interests are in Formal Methods, Model Based Development, Software Testing and Automata Theory.

Course certificate

The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: **30 October 2022** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12





in the course.

of the proctored certification exam score of the course. About Swayam (<https://swayam.gov.in/about>) | All Courses |

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Final score = Average assignment score + Exam score



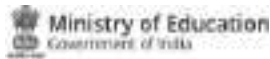
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SCORE >= 10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you
will not get the certificate even if the Final score >= 40/100.**

Certificate will have your name, photograph and the score in the final exam with the
breakup.It will have the logos of NPTEL and IIT Madras .It will be e-verifiable at
nptel.ac.in/noc (<http://nptel.ac.in/noc>).

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**Prof. Meenakshi
D'souza**

IIIT Bangalore

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Final score = Average assignment score + Exam score



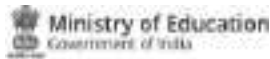
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STRATEGY: AN INTRODUCTION TO GAME THEORY

PROF. ADITYA K JAGANNATHAM

Department of Electrical Engineering
IIT Kanpur

PROF. VIMAL KUMAR

Department of Economic Sciences
IIT Kanpur

INTENDED AUDIENCE : Students: Engineering, Management, Economics, Mathematics Professionals: Engineers, Scientists, Managers, Economists, Academicians, Policy Makers

INDUSTRIES APPLICABLE TO : This is an undergraduate core course required as a foundation to other courses in Microwave, Optical, and Antenna engineering.

COURSE OUTLINE :

Games or 'Strategic Interactions' can be found in all walks of life. Examples of such scenarios are two firms competing for market share, politicians contesting elections, different bidders participating in an auction for wireless spectrum, coal blocks etc. Game theory provides a convenient framework to model and interpret the behaviour of participants in such strategic interactions. Hence it can be applied to solve a wide variety of problems involving diverse areas such as Markets, Auctions, Online Retail, Cold War, Paying Taxes, Bargaining, Elections, Portfolio Management etc. Therefore, both undergraduate and postgraduate students and professionals from diverse backgrounds such as Scientists, Engineers, Managers, Politicians and Political Scientists, Economists, Mathematicians etc will find the course content useful. Examples and exercises will be motivated by problems close to real life scenarios.

ABOUT INSTRUCTOR :

Prof. Aditya K. Jagannatham received his Bachelors degree from the Indian Institute of Technology, Bombay and M.S. and Ph.D. degrees from the University of California, San Diego, U.S.A. From April '07 to May'09 he was employed as a senior wireless systems engineer at Qualcomm Inc., San Diego, California, where he was a part of the Qualcomm CDMA technologies (QCT) division. His research interests are in the area of next-generation wireless cellular and WiFi networks, with special emphasis on various 5G technologies such as massive MIMO, mmWave MIMO, FBMC, NOMA, Full Duplex and others. He has contributed to the 802.11n high throughput wireless LAN standard and has published extensively in leading international journals and conferences. He was awarded the CAL(IT)2 fellowship at the University of California San Diego and the Upendra Patel Achievement Award at Qualcomm. He is currently a Professor in the Electrical Engineering department at IIT Kanpur, where he holds the Arun Kumar Chair Professorship, and is also associated with the BSNL-IITK Telecom Center of Excellence (BITCOE). He has been twice awarded the P.K. Kelkar Young Faculty Research Fellowship for excellence in research, the Qualcomm Innovation Fellowship (QInF) and the IIT Kanpur Excellence in Teaching Award. His popular video lectures for the NPTEL (National Programme on Technology Enhanced Learning) course on Advanced 3G and 4G Wireless Mobile Communications can be found at the following YouTube link (NPTEL 3G/4G). He has also successfully conducted several Massive Open Online Courses (MOOCs) on various topics such as Applied Game Theory, MIMO OFDM Wireless Systems, Probability and Random Processes, Signals and Systems, Principles of Communication Systems, which have been widely adopted and appreciated. A book authored by him titled Principles of Modern Wireless Communications Systems has been published by McGraw Hill Education and comprehensively covers several key aspects of modern wireless technologies.

Prof. Vimal Kumar received his Ph.D. in Economics from the University of California Irvine in 2008 and B. Tech. in Mechanical Engineering and M. Tech in Thermal Fluid Engineering under a dual degree program from the Indian Institute of Technology Bombay in 2003. After finishing his Ph.D. program in July 2008, he joined the Delhi office of Watson Wyatt Worldwide, a multinational consultancy organization. He worked for one year as a Consultant/Economist in the Global Research Division of the firm. In June 2009, he joined the Indian Institute of Technology (IIT) Kanpur as Assistant Professor. In June 2015, he became Associate Professor, and in December 2019, he became a Professor. Currently, he is the head of the Department of Economic Sciences at IIT Kanpur. He is also a coordinator for NPTEL program at IIT Kanpur.

He is the recipient of several awards and fellowships, including the class of 1982 research fellowship given by IIT Kanpur, the best research paper award for the year 2011 by the American Political Science Association, the Social Science Merit fellowship from the University of California Irvine for years 2003 to 2008, and National Talent Search Scholarship (NTSE) from NCERT, India.

He has participated in 5 sponsored research grants and organized more than 15 workshops in Game Theory and Power System Economics. He has delivered more than 25 guest lectures.

COURSE PLAN :

Week 1: Normal Games and Nash Equilibrium.

Week 2: Mixed Strategies.

Week 3: Sequential Games.

Week 4: Games with Incomplete Information.

Week 5: Auctions

Week 6: Repeated Games

Week 7: Cooperative Games

Week 8: Bargaining and Negotiation



Sustainable Engineering Concepts and Life Cycle Analysis

Prof. Brajesh Kumar Dubey

Department of Civil Engineering
IIT Kharagpur

INTENDED AUDIENCE: Any interested learners.

PRE-REQUISITES : Environmental Sciences, Introduction to Environmental Engineering

INDUSTRIES APPLICABLE TO : list of companies/industry that will recognize/value this online course, Larsen and Turbo, Tata Group of Industries.

COURSE OUTLINE :

This course will introduce students to the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society. Students will understand the concepts and the scientific method as it applies to a systems-based, trans-disciplinary approach to sustainability, and will be prepared to identify problems in sustainability and formulate appropriate solutions based on scientific research, applied science, social and economic issues. The basic concepts of life cycle assessment (LCA) will be discussed, along with life cycle inventory (LCI) and life cycle impact assessment (LCIA) including the social and economic dimensions. The application of life cycle assessment methodology using appropriate case studies will be presented.

ABOUT INSTRUCTOR :

Prof. Brajesh Kr. Dubey has his bachelors degree in Civil Engineering (Hons) from Indian Institute of Technology (IIT) Kharagpur, India and PhD in Environmental Engineering Sciences, University of Florida, Gainesville, Florida, USA. He is presently Associate Professor (Integrated Waste Management and Sustainable Engineering) in the Division of Environmental Engineering and Management at Indian Institute of Technology (IIT), Kharagpur, India. Dr. Dubey has more than 17 years of research, teaching, training and industrial outreach experience in the areas of Integrated Solid and Hazardous Waste Management, and Sustainable Engineering and Application of Life Cycle Assessment techniques. He also works in the area of Life Cycle Analysis and Sustainable Engineering. He has been teaching courses in the area of Solid Waste Management, Hazardous Waste Management, Life Cycle Analysis and Environmental Risk Assessment among other courses for nearly a decade. He has taught at several universities in USA, Canada, New Zealand, China and India. He has also conducted training programs in the Integrated Waste Management areas including that for Electronics Waste. Dr. Dubey has authored/co- authored more than 200 publications in his area of expertise and have presented at several national and international conferences. He has worked as Waste Management Expert for UN agencies and World Bank.

COURSE PLAN :

Week 1: An Introduction to Sustainability Concepts and Life Cycle Analysis (Introduction, Material flow and waste management, What it all means for an engineer? Water energy and food nexus)

Week 2: Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Environmental Risk Assessment, Example Chemicals and Health Effects, Character of Environmental Problems)

Week 3: Environmental Data Collection and LCA Methodology (Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools)

Week 4: Life Cycle Assessment – Detailed Methodology and ISO Framework (Detailed Example on LCA Comparisons, LCA Benefits and Drawbacks, Historical Development and LCA Steps from ISO Framework)

Week 5: Life Cycle Inventory and Impact Assessments (Unit Processes and System Boundary Data Quality, Procedure for Life Cycle Impact Assessment, LCIA in Practice with Examples, Interpretation of LCIA Results)

Week 6: Factors for Good LCA Study (ISO Terminologies, LCA Steps Recap, Chemical Release and Fate and Transport, and Green Sustainable Materials)

Week 7: Design for Sustainability (Environmental Design for Sustainability: Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles and Environmental Cost Analysis)

Week 8: Case Studies (e.g., Odour Removal for Organics Treatment Plant, Comparison of Hand Drying Methods, Biofuels for Transportation, Kerosene Lamp vs. Solar Lamp, Bioplastic etc.).



SUSTAINABLE TRANSPORTATION SYSTEMS

PROF. BHOLA RAM GURJAR

Department of Civil Engineering
IIT Roorkee

INTENDED AUDIENCE : PG/Pre-PhD (UG Students, Professionals and Policy Makers can also attend)

INDUSTRIES APPLICABLE TO : Automobile, road and transportation related other industries may find this course informative.

COURSE OUTLINE :

The objective of the course is to impart knowledge and skills of environmental issues related to transportation systems, concept of sustainability and related issues. The course includes the various environmental aspects of mass rapid transportation systems, air quality management through transportation planning in mega cities and current case studies regarding the same.

ABOUT INSTRUCTOR :

Prof. Bhola Ram Gurjar holds a PhD in the area of Environmental Risk Analysis from India's premier technological institution I.I.T. Delhi followed by Postdoctoral research at the Max Planck Institute for Chemistry (MPIC) in Mainz, Germany. He is a Professor of Environmental Engineering in Civil Engineering Department and a Joint Faculty in Centre of Excellence for Sustainable Transportation Systems (CTRANS) at I.I.T. Roorkee. He has been Dean of Resources and Alumni Affairs (DORA) from June 2017 - April 2021 and Head of CTRANS from February 2015 - February 2018 at IIT Roorkee. He has also headed the Max Planck Partner Group for Megacities & Global Change at IIT Roorkee from 2006-2011. Prof. Gurjar has about 30 years' progressive professional experience in industry, teaching, training, research, and consultancy. He is among the leading academics and researchers who have worked extensively in the area of environmental science and engineering specially focused on air and water pollution, and environmental quality and health risk assessment, which is reflected in his several highly cited research papers published on these themes. His present research interests include megacities; air and water pollution; environmental impact and risk assessment; atmospheric emissions and climate change; Biofuels and their emissions, and integrated cross-disciplinary study of science and policy issues of the environment, health, energy, economy, technology, infrastructure and resources – particularly from the global change, sustainable development and risk governance perspectives.

COURSE PLAN :

Week 1: Introduction to Environmental Impact Assessment (EIA) and Transportation systems

Week 2: Land-use plans, zoning schemes and provisions

Week 3: Urban and regional transport planning

Week 4: Impacts on humans, flora and fauna, soil, water, air, climate and landscape

Week 5: Establishment of baseline conditions w.r.t soil, water and air quality

Week 6: Noise, air and water pollution modelling

Week 7: Modelling of impacts and scenario-based analysis

Week 8: Assessment of potential project impacts including indirect, cumulative and synergistic impacts

Week 9: Decision support systems for EIA of transport infrastructures

Week 10: Abatement measures

Week 11: Sustainable transportation systems

Week 12: Case studies of highway, railway and airport projects, OpenLCA tool for life Cycle Assessment, STAN for material flow analysis



SYSTEM DESIGN THROUGH VERILOG

PROF. SHAIK RAFI AHAMED

Department of Electronics & Electrical Engineering
IIT Guwahati

PRE-REQUISITES : Digital Circuits

INTENDED AUDIENCE : Undergraduate, post graduate students, faculty and industry people

INDUSTRIES APPLICABLE TO : Cadence/Mentor graphics

COURSE OUTLINE :

A comprehensive resource on Verilog HDL for beginners and experts large and complicated digital circuits can be incorporated into hardware by using Verilog, a hardware description language (HDL). A designer aspiring to master this versatile language must first become familiar with its constructs, practice their use in real applications, and apply them in combinations in order to be successful. Design Through Verilog HDL affords novices the opportunity to perform all of these tasks, while also offering seasoned professionals a comprehensive resource on this dynamic tool.

ABOUT INSTRUCTOR :

Prof. Shaik Rafi Ahamed is a professor with more than 20 years teaching experience. He had taught Digital design including verilog nearly 10 times for undergraduate students at IIT Guwahati and other institutions. He have published several papers in reputed Journals like IEEE, Elsevier, IET and Springer.

COURSE PLAN :

Week 1: Introduction to Verilog

Week 2: Gate level modelling

Week 3: Behavioral modelling I

Week 4: Behavioral modelling II

Week 5: Data flow modelling

Week 6: Switch level modelling

Week 7: Synthesis of combinational logic using verilog

Week 8: Synthesis of sequential logic using verilog



THE JOY OF COMPUTING USING PYTHON

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

INTENDED AUDIENCE : Any interested audience

PREREQUISITES : 10th standard/high school

INDUSTRY SUPPORT : Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!



THE PSYCHOLOGY OF LANGUAGE

PROF.NAVEEN KASHYAP

Department of Humanities and Social Sciences
IIT Guwahati

INTENDED AUDIENCE : Students, Teachers

COURSE OUTLINE :

The very basic form of exchanging information between two living beings is termed as communication. A highly developed form of communication is language, which is used mostly by human beings. The present course will introduce the concept of language and the psychology behind the learning and using of language

ABOUT INSTRUCTOR :

Prof. Naveen Kashyap, Ph.D is as Associate Professor of Psychology at the Indian Institute of Technology Guwahati. His research interests are sleep and human cognitive processes. Dr Kashyap has been teaching courses like cognitive psychology, introduction to psychology, consumer psychology, advance cognitive process and research methodology to UG and PG students of Guwahati for the past 10 years.

COURSE PLAN :

Week 1: Communication and Language

Week 2: The Science of Language

Week 3: Speech Perception

Week 4: Speech Production

Week 5: Words

Week 6: Sentences

Week 7: Discourse

Week 8: Reading and Writing



WELDING APPLICATION TECHNOLOGY

PROF. PANKAJ BISWAS

Department of Mechanical Engineering
IIT Guwahati

INTENDED AUDIENCE : Students (UG and PG); Participant from any manufacturing industry

PREREQUISITES : BE/BTech In Mechanical/Production/ Manufacturing Sciences/Power Plant Engg/
Naval And Architecture Engg

COURSE OUTLINE :

The name of the course is Welding Application Technology. As the name implies in this course I will try to cover the fundamental overview of the traditional/ industrial welding technology especially those welding processes which are widely used in manufacturing industries. I will also try to cover the detail concepts of design and analysis of welding joints, heat treatment and weld induced residual stresses & distortions and its measurement. This will help the participants to understand and apply this knowledge of welding in practice for various industrial applications. It will also encourage academic participants to increase the research interest in the field of welding. In this present course the primary focus is on basic fundamental of welding and its importance in industries.

The brief overview of the course content can be stated like; this course will cover the industrial relevance of welding processes. It will give the fundamental knowledge of various important welding processes which includes most of the important fusion welding, solid state welding (i.e. Friction Welding, FSW etc.) and solid-liquid state welding (i.e. Shouldering and Brazing). It will also cover the importance and applications of all these welding techniques. This course will highlight the safety precautions to be followed in different welding techniques.

This course also will cover the basic concepts of weld induced residual stresses and distortions. In this course, the concepts of different residual stresses measurements techniques will be provided. This course also will provide the fundamental concepts of residual stresses and distortions mitigation techniques. This course also will provide the basic fundamental concept on design and analysis of welding joints. This course includes most of the important topics related to static analysis of welded joints which included 'Design and Analysis of Butt and Fillet Welds Joints, Strength Calculation of Parallel & Transverse Fillet Welds, Analysis of Eccentrically Loaded Welded Joint, Analysis of Welded Joint Subjected to Bending Moment'.

ABOUT INSTRUCTOR :

I, Prof. Pankaj Biswas, am a Professor in the Dept. of Mechanical Engineering, IIT Guwahati. I did my B.E. in Mechanical Engineering from IEST, Shibpur. I did my M-Tech and PhD from IIT Kharagpur. I am working in the area of different manufacturing as well as design fields. I am working in the area of welding technology, 3-D printing and forming by line heating for the past 17 years. My areas of research are on computational weld mechanics, similar and dissimilar friction stir welding, friction stir welding of steel, hybrid welding technology, Finite Element analysis of weld induced distortion and residual stresses, Analysis of large welding structure, forming by line heating and modeling of welding processes using soft computing techniques. I guided 01 PDF, 10 PhD scholars, 40 M-Tech students and 35 B-Tech students in the area of welding, forming and 3D printing. Currently, I am guiding 02 NPDP, 08 PhD scholars in the areas of welding, 3-D printing and line heating. I already published about 105 journal articles, 95 conference proceedings, 25 book chapters and 04 patents. I worked in ten sponsored / consultancy projects. Currently, I am working in another eight sponsored / consultancy projects. I got IEI Young Engineers Award 2013- 2014' in Mechanical Engineering discipline.

COURSE PLAN :

Week 1: Basics of welding residual stresses & distortions and its mitigation

Week 2: Measurement & analysis of welding residual stresses and distortions

Week 3: Measurement of welding residual stresses and distortions

Week 4: Different type of welding methods and its details (PAW, FCAW, RSW)

Week 5: Different type of welding methods and its details (RW, Thermit, FSW)

Week 6: Different type of welding methods & its details (Brazing, Soldering)

Week 7: Design & analysis of butt and fillet welds joints

Week 8: Design & analysis of weld joints for different static loading conditions



WELDING PROCESSES

PROF. MURUGAIYAN AMIRTHALINGAM

Department of Metallurgy and Material Science
IIT Madras

PRE-REQUISITES : Graduates of Metallurgical/Mechanical/Automobile/Production Engineering

INTENDED AUDIENCE : Masters students in Metallurgical, Mechanical, Automobile and Production Engineering. Practicing welding engineers, welders, R&D personnel in academia and national laboratories, quality management personnel from welding and manufacturing industries and research scholars who are working in welding and joining.

INDUSTRIES APPLICABLE TO : Construction, Fabrication, Automobile and Power generation industries and research labs

COURSE OUTLINE :

The modern material assemblies require the combined use of alloys for a given commercial application. Welding technologies are of critical importance for the construction of virtually all components of the assemblies. This course aims to elaborate the physical principles of arc, plasma, laser, resistance spot, electron beam and solid state welding processes. This includes, physics of electric arc-plasma, engineering the arc-plasma for welding, metal transfer and mass flow in the weld pool, laser/electron beam - material interactions, pressure and force balance in keyhole mode power beam welding, fundamentals of heat generation by Joule heating and process principles and overview on types of resistance and solid state welding processes.

ABOUT INSTRUCTOR :

Prof. Murugaiyan Amirthalingam is currently working as an Assistant Professor in IIT-Madras. His research and teaching interests include welding metallurgy, welding processes development, steel product development and additive manufacturing.

COURSE PLAN :

Week 1 : Introduction to the course, learning outcomes, general survey and classification of welding processes, Conventional fusion welding processes, Principal heat sources

Week 2 : Physics of welding arc – Part I General characteristics of an arc, ionisation, dissociation, arc column, anode and cathode fall zones.

Week 3 : Physics of welding arc – Part II Electrical conductivity of the arc, heat transfer inside the arc and arc ignition.

Week 4 : Introduction to arc welding processes – Part I Principles of gas tungsten arc welding, plasma arc welding, advances in gas tungsten arc welding

Week 5 : Electrical power sources for welding - General characteristics, conventional and electronic power regulator systems - Tapped transformers, Moving-iron control, Variable inductor, Magnetic amplifier, SCR phase control, Transistor series regulator, Secondary switched transistor power supplies, Primary rectifier-inverter, hybrid designs and microprocessor controlled power sources.

Week 6 : Introduction to arc welding processes – Part II Gas metal arc, shielded metal arc, flux cored arc, submerged arc welding -consideration of shielding gases, electrode polarity, current setting, types of metal transfer, process efficiency, melting rate, spatter losses and influence of external magnetic field on arc stability and Advanced GMAW processes. Electrode coverings and their functions, types of fluxes,

Week 7 : Fundamentals of resistance welding – Part I Process principles and overview on types of processes (spot, projection, butt, seam, and flash) Joule effect and temperature distribution.

Week 8 : Fundamentals of resistance welding – Part II Process application range and typical problems (welding thin to thick material, welding of coated/ painted materials, welding dissimilar materials, mass effect, shunt effect, Peltier effect, resistance brazing).

Week 9 : Introduction to power beam welding processes Plasma, laser and electron beam welding processes - principles and modes of operation, applications and advantages.

Week 10 : Principles of power beam welding processes Keyhole formation, power densities, forces acting in keyhole, pressure balance for a generalised keyhole, heat transfer in laser and electron beam welding processes.

Week 11 : Introduction to pressure welding processes - solid state bonding, friction welding, friction stir welding, ultrasonic welding, explosive welding, diffusion bonding and adhesive bonding.

Week 12 : Principles and operational considerations of pressure welding processes



ADVANCED CONCRETE TECHNOLOGY

PROF. MANU SANTHANAM

Department of Civil Engineering
IIT Madras

INTENDED AUDIENCE : Post-graduate students, and final year undergraduate students

PRE-REQUISITES : Basic course on Construction Materials in UG level. Additional course on Concrete Technology (UG level) is optional.

INDUSTRIES APPLICABLE TO : Civil contracting firms, Ready mixed concrete companies, Cement companies, Construction chemicals companies, Materials research laboratories etc

COURSE OUTLINE :

This course explores the materials science of concrete, and attempts to bring about the understanding of concrete behavior from a fundamental perspective. The first part of the course discusses the structure and properties of concrete making materials. This is followed by mixture proportioning of high performance concrete, and a study of selected topics regarding fresh and hardened concrete behavior. The final part of the course deals with long term performance issues, related to creep, shrinkage and durability of concrete.

ABOUT INSTRUCTOR :

Prof. Manu Santhanam is a Professor in the Department of Civil Engineering at IIT Madras, where he has worked since October 2001. His primary research interests are in Cement Chemistry, Durability of Concrete and Non-Destructive Evaluation. He has published more than 75 refereed journal papers, and has guided 10 PhD theses, in addition to being lead investigator on several sponsored projects.

COURSE PLAN :

Week 01 : Cement production and composition

Week 02 : Cement chemistry

Week 03 : Aggregates for concrete

Week 04 : Chemical admixtures

Week 05 : Chemical and Mineral admixtures

Week 06 : Mineral admixtures

Week 07 : High performance concrete mixture proportioning

Week 08 : Topics in fresh concrete

Week 09 : Topics in hardened concrete

Week 10 : Creep and shrinkage

Week 11 : Durability of concrete

Week 12 : Durability of concrete



ADVANCED MACHINING PROCESSES

PROF. MANAS DAS

Department of Mechanical Engineering
IITGuwahati

INTENDED AUDIENCE : Intended for UG and PG students who plan to take up this subject as their future research area. Also, for practitioner in industries who want to implement new development technologies in advanced machining to their factory.

INDUSTRIES APPLICABLE TO : Bharat Heavy Electricals Limited (BHEL), Hindustan Aeronautics Limited (HAL), Defense Research and Development Organization (DRDO), Die manufacturing industries, Automobile Industries, Machine Tool Industries, Precision medical equipment manufacturing industries, High precision optics and semiconductor industries

COURSE OUTLINE :

There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and workpieces with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called unconventional in the sense that conventional tools are not employed for metal cutting. Instead, energy in its direct form is used to remove the material from the workpiece. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of unconventional / nontraditional / modern machining processes.

ABOUT INSTRUCTOR :

Prof. Manas Das is an Assistant Professor in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati, India since 2012. He received his Masters and Ph.D. degree from Mechanical engineering Department, IIT Kanpur. His research areas include Advanced Finishing and Nano-finishing Processes, Magnetorheological Finishing (MRF) Process, Advanced/Non-traditional Machining Processes, Micromachining processes. Dr. Das has published more than 20 papers in reputed journal and conferences. He has also written 2 book chapters in the area of surface finishing. Presently, he is supervising 5 Ph.D. students in the broad area of manufacturing.

COURSE PLAN :

Week 1 : Introduction to advanced machining processes and their classification
Ultrasonic machining and its modelling and analysis

Week 2 : Abrasive jet machining (AJM)

Water jet cutting (WJC) and Abrasive water jet machining (AWJM)
Magnetic abrasive finishing (MAF) and its modelling

Week 3 : Abrasive flow finishing (AFF) and its modelling
Magnetorheological finishing (MRF)

Week 4 : Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis

Week 5 : Electric discharge machining (EDM): Principle, applications, process parameters, and modelling

Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM)

Week 6 : Laser beam machining (LBM)

Plasma arc machining (PAM)
Electron Beam Machining (EBM)

Week 7 : Electro chemical machining (ECM): Principle, applications, and process parameters and modelling

Week 8 : Electrochemical Grinding (ECG), Electrostream Drilling (ESD), Shaped Tube Electrolytic Machining (STEM), Chemical machining (ChM)



BASIC PRINCIPLES AND CALCULATIONS IN CHEMICAL ENGINEERING

PROF. SUBRATA KUMAR MAJUMDAR

Department of Chemical Engineering

IIT Guwahati

PRE-REQUISITES : 10+2 Examination in science

INTENDED AUDIENCE : Chemical, BioChemical, chemical science and Technology / Chemical Engineering Petroleum science and technology

INDUSTRIES APPLICABLE TO : Industrial Research and development section of chemical and Biochemical Engineering

COURSE OUTLINE :

The objective of the course is to introduce chemical engineering students to the basic principles and calculation techniques used in the chemical industries and to acquaint them with the fundamentals of the material and energy balances as applied to chemical engineering processes. The course is mainly intended for graduate chemical engineering student. It will expose them to solve the problems in material and energy balances that arise in relation to the problems involving in different chemical process units. It also will introduce them to numerical methods used to solve the problems. The course will introduce in simple language and ample of examples so that it will encourage learners to get used to the course.

ABOUT INSTRUCTOR :

Prof. Subrata Kumar Majumder is a Professor in the Chemical Engineering Department, IIT Guwahati, India. His research interests include multiphase flow and reactor development, hydrodynamics in multiphase flow, mineral processing, process intensifications and micro-nano bubble science and technology and its applications. He is a Fellow of the International Society for Research and Development, 8A Kapteinsvigein, London, UK. He is also a recipient of various honours and awards like: Editor, Journal of Chemical Engineering Research Studies, Guest editor, American Journal of Fluid Dynamics, published by Scientific & Academic Publishing Co., CA, 91731, USA, Editorial board member of Scientific Journal of Materials Science, IIME Award on beneficitation from Indian Institute of Mineral Engineers (IIME), Editorial board Member of the Journal of Science and Technology, Scientific and Academic Publishing, USA, Advisory board member of Excelling Tech Publishers (ETP), London, UK. He is a life member of Indian Institute of Chemical Engineers, Indian Institute of Mineral Engineers, member of Institute of Engineers (India), Member of Asia-Pacific Chemical, Biological & Environmental Engineering Society (PCBEE), senior member of International Association of Engineers (IAE), Japan. He authored four books, five book chapters, and has more than 80 publications in several reputed international journals. Presently he is working in the field of Microbubble science and technology and its applications in mineral beneficiation, food processing and arsenic, ammonia and dye removal and process intensifications by developing ejector-induced gas aided extraction process.

COURSE PLAN :

Week 1: Introduction

Contents:

Definition, history and role of chemical engineers: Definition of chemical engineering, role of chemical engineers in society

Basic features of chemical process: Classifications and modes of chemical processes; basic features of chemical process and unit operation

Unit systems and dimensions: Dimensional homogeneity and its analysis, Analysis of problem with solution

Week 2: Process Variables and Rate

Contents:

Variables and properties of material in systems: Physical and transport properties of materials and mixtures, Analysis of problem with solution

Pressure and temperature of flow process: Pressure and temperature and their measurements in flow process, problem solving

Rate of chemical processes: Flow rate and its measurements, Flow rate and its measurements, Rate of momentum transfer, Rate of heat transfer, Rate of mass transfer, Analysis of problem with solution Solving problems³

Week 3: Fundamentals of Material Balance

Contents:

Principles of material balance and its calculation: basis of engineering calculations, the general material balance equation, Balances on single and multiple unit processes without reaction, Solving problems

Material balances on non-reactive processes: Material balances on non-reactive processes with recycle and bypass, Solving problems

Material balances on reactive processes: Material balances on reactive processes, Solving problems

Material balances on combustion processes: Material balances based on combustion reactions, Solving problems

Week 4: Basic Principles of Compressible System

Contents:

State equation of ideal gas and calculation: Basic equations of state for ideal gas and their calculations;

State equation of non-ideal gas and calculation: Basic equations of state for non-ideal gas and their calculations

Week 5: Basic Principles of Multiphase System

Contents:

Phase equilibrium and Vapour Pressure: Phase equilibrium, Gibb's phase law, Clausius-Clapeyron Equation, Antoine's Equation, Cox Chart

Equilibrium laws: Raoul's Law, Henry's law, volatility, their calculations with examples

Saturation and Humidity: Principles of saturation, humidity, Psychrometric chart and its use, problem solving

Process of phase change: Condensation, vaporization, Examples

Week 6: Energy and Its Forms

Contents:

Principles of Energy: concepts and units, Different forms of energy and their calculations, The general energy balance equation

Laws and Properties of thermodynamics: Laws of thermodynamics, definitions of thermodynamic properties like Heat capacity, enthalpy, entropy; Calculation of enthalpy changes (without change of phase), enthalpy changes for phase transitions

Heat of formation, reaction and solution: Definition and calculations

Week 7: Energy Balances on Non-reactive Processes

Contents:

The mechanical energy balance: basic understanding with example

Enthalpy balances without reaction: basic understanding with example

Energy balances on non-reactive processes of multiple inlet and outlet streams: basic understanding with example

Enthalpy balances for heat of solution: Analysis with example

Week 8: Energy Balances on Reactive Systems

Contents:

Energy balance with standard heat of reaction: basic understanding with example

Energy balance with heat of reaction: basic understanding with example

Energy balances on heat of combustion: basic understanding with example

Week 9: Balances on Unsteady State Processes

Contents:

Material balances of unsteady state process: basic understanding with example

Unsteady state energy balance: basic understanding with example; Example of simultaneous material and energy balance

Week 10: Computational Techniques

Contents:

The methods of least squares: Linear equation fitting with experimental data with example

Non-linear algebraic equation system: basic understanding with example

Numerical Integration: basic understanding with example

Week 11: Computer-aided Balance Calculations

Contents:

Degree of freedom analysis: basic understanding with example

Process flow sheeting and codes: basic understanding

Week 12: Case Studies on Chemical Process

Contents:

Case study-I on chemical process: Analysis with example

Case study-II on chemical process: Analysis with example 3



BASICS IN INORGANIC CHEMISTRY

PROF. D. MAITI

Department of Chemistry

IIT Bombay

PRE-REQUISITES : Basic Chemistry courses, Basic Mathematics from school, 10+2 standard

INTENDED AUDIENCE : Undergraduate students belonging to Science and Engineering

COURSE OUTLINE :

This course will mainly deal with basics of Inorganic Chemistry. This includes periodic properties of the elements, source and extraction of metals. The study of transition metals comprises major portion of Inorganic Chemistry. Therefore, we will discuss some common properties like crystal field stabilization energy, magnetic properties, spectroscopic properties and uses of these properties in various fields including biological systems.

ABOUT INSTRUCTOR :

I am Prof. Debabrata Maiti, Associate Professor at IIT Bombay. I have completed PhD from Johns Hopkins University with Prof. Kenneth D. Karlin in bioinorganic chemistry. Then I moved to MIT where I did my Post-doctoral research with Prof. Steven Buchwald. I have started independent carrier at IIT Bombay in 2011 and since then involved actively in teaching bio-inorganic chemistry and organometallic chemistry. Our group is also active in research areas of bio-inorganic chemistry and C-H activation.

COURSE PLAN :

Week 1: Basics in Inorganic Chemistry

Week 2: Purification of elements; Coordination Chemistry; 18 electron rule; Valence bond theory; Crystal field theory

Week 3: Term symbols; Spectroscopy of complexes; Jahn-Teller distortion; Spinels; Magnetism

Week 4: Bio-inorganic Chemistry, Enzymes; Hemoglobin and Myoglobin; Toxicity; Medicinal inorganic compounds



BIG DATA COMPUTING

PROF. RAJIV MISRA

Department of Computer science and engineering
IIT Patna

PRE-REQUISITES : Data Structure & Algorithms, Computer Architecture, OperatingSystem, Database Management Systems

INDUSTRY SUPPORT : Companies like Amazon, Microsoft, Google, IBM, Facebook

COURSE OUTLINE :

In today's fast-paced digital world , the incredible amount of data being generated every minute has grown tremendously from sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction records, and GPS signals from cell phone to name a few. This amount of large data with different velocities and varieties is termed as big data and its analytics enables professionals to convert extensive data through statistical and quantitative analysis into powerful insights that can drive efficient decisions. This course provides an in-depth understanding of terminologies and the core concepts behind big data problems, applications, systems and the techniques, that underlie today's big data computing technologies. It provides an introduction to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce, Large scale data storage technologies such as in-memory key/value storage systems, NoSQL distributed databases, Apache Cassandra, HBase and Big Data Streaming Platforms such as Apache Spark Streaming, Apache Kafka Streams that has made big data analysis easier and more accessible. And while discussing the concepts and techniques, we will also look at various applications of Big Data Analytics using Machine Learning, Deep Learning, Graph Processing and many others. The course is suitable for all UG/ PG students and practicing engineers/ scientists from the diverse fields and interested in learning about the novel cutting edge techniques and applications of Big Data Computing.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is working in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelor's of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile, Adhoc and Sensor Networks, Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 70 papers in high quality journals and conferences, and 2 book chapters. His h-index is 10 with more than 590 citations. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, IEEE Systems Journal, Adhoc Networks, Computer Network, Journal of Parallel and Distributed Computing. He has edited a book titled as "Smart Techniques for a Smarter Planet: Towards Smarter Algorithms" for the "Studies in Fuzziness and Soft Computing" book series, Springer (2018). He has supervised four Phd students and currently four Phd students working under his supervision in the area of big data, cloud computing, distributed computing, and sensor networks. He is a senior member of the IEEE and fellow of IETE. He has completed as the Principal Investigator of R&D Project Sponsored by DeITY entitled as "Vehicular Sensor and Mesh Networks based Future ITS". He has mentored the online courses on Cloud Computing, Advanced Graph Theory and Distributed Systems in the platform of NPTEL

COURSE PLAN :

Week 1: Introduction to Big Data

Week 2: Introduction to Enabling Technologies for Big Data

Week 3: Introduction to Big Data Platforms

Week 4: Introduction to Big Data Storage Platforms for Large Scale Data Storage

Week 5: Introduction to Big Data Streaming Platforms for Fast Data

Week 6: Introduction to Big Data Applications (Machine Learning)

Week 7: Introduction of Big data Machine learning with Spark

Week 8: Introduction to Big Data Applications (Graph Processing)



CHARACTERIZATION OF CONSTRUCTION MATERIALS

PROF. MANU SANTHANAM

Department of Civil Engineering
IIT Madras

PROF. PIYUSH CHAUNSALI

Department of Civil Engineering
IIT Madras

TYPE OF COURSE : New | Elective | PG
COURSE DURATION : 12 weeks (27 Jan' 20 - 17 Apr' 20)
EXAM DATE : 26 Apr 2020

PRE-REQUISITES : Basic Civil Engineering degree

INTENDED AUDIENCE : Interested Learners

INDUSTRIES APPLICABLE TO : Cement companies, Concrete Producers, Construction chemical manufacturers, Construction companies

COURSE OUTLINE :

The objective of the course is to introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials. The course will be focused primarily on cement and concrete, and include a few techniques; the physics of the techniques and their application to cement science. Lab demonstrations and experiments will be covered.

ABOUT INSTRUCTOR :

Dr. Manu Santhanam is a Professor at the Department of Civil Engineering at IIT Madras. His research interests are in multi-scale characterization of concrete, supplementary cementing materials, durability and non-destructive evaluation

Dr. Piyush Chaunsali is an Assistant Professor at the Department of Civil Engineering at IIT Madras. His research focuses on the use of principles of materials science, life-cycle assessment and structural engineering to design sustainable building materials

COURSE PLAN :

Week 1: Introduction to course; Structure of Construction Materials – An Overview

Week 2: Calorimetry

Week 3: X-ray diffraction

Week 4: X-ray diffraction, cont'd

Week 5: Thermal analysis

Week 6: Surface area measurement

Week 7: Optical microscopy

Week 8: Scanning electron microscopy

Week 9: Image analysis

Week 10: Spectroscopic techniques

Week 11: Mercury intrusion porosimetry

Week 12: Impedance analysis and ultrasonic methods



Cloud Computing

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE,ECE,EE

PREREQUISITES : Basics of Computer Architecture and Organization, Networking

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE:

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

ABOUT THE INSTRUCTOR:

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN:

- Week 1:** Introduction to Cloud Computing
- Week 2:** Cloud Computing Architecture
- Week 3:** Service Management in Cloud Computing
- Week 4:** Data Management in Cloud Computing
- Week 5:** Resource Management in Cloud
- Week 6:** Cloud Security
- Week 7:** Open Source and Commercial Clouds, Cloud Simulator
- Week 8:** Research trend in Cloud Computing, Fog Computing
- Week 9:** VM Resource Allocation, Management and Monitoring
- Week 10:** Cloud-Fog-Edge enabled Analytics
- Week 11:** Serverless Computing and FaaS Model
- Week 12:** Case Studies and Recent Advancements



CLOUD COMPUTING AND DISTRIBUTED SYSTEMS

PROF. RAJIV MISRA

Department of Computer Science and Engineering
IIT Patna

PRE-REQUISITES : Minimum: Data Structures and Algorithms; Ideal: Computer Architecture, Basic OS and Networking concepts

INDUSTRIES SUPPORT : Companies like Amazon, Microsoft, Google, IBM, Facebook and start-ups working on this field.

COURSE OUTLINE :

Cloud computing is the on-demand delivery of computations, storage, applications, and other IT resources through a cloud services platform over the internet with pay-as-you-go business model. Today's Cloud computing systems are built using fundamental principles and models of distributed systems. This course provides an in-depth understanding of distributed computing "concepts", distributed algorithms, and the techniques, that underlie today's cloud computing technologies. The cloud computing and distributed systems concepts and models covered in course includes: virtualization, cloud storage: key-value/NoSQL stores, cloud networking, fault-tolerance cloud using PAXOS, peer-to-peer systems, classical distributed algorithms such as leader election, time, ordering in distributed systems, distributed mutual exclusion, distributed algorithms for failures and recovery approaches, emerging areas of big data and many more. And while discussing the concepts and techniques, we will also look at aspects of industry systems such as Apache Spark, Google's Chubby, Apache Zookeeper, HBase, MapReduce, Apache Cassandra, Google's B4, Microsoft's Swan and many others. Upon completing this course, students will have intimate knowledge about the internals of cloud computing and how the distributed systems concepts work inside clouds.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is an Associate Professor in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelors of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile, Adhoc and Sensor Networks, Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 70 papers in high quality journals and conferences, and 2 book chapters. His h-index is 10 with more than 590 citations. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, Adhoc Networks, Journal of Parallel and Distributed Computing.

COURSE PLAN :

Week 1: Introduction to Clouds, Virtualization and Virtual Machine

1. Introduction to Cloud Computing: Why Clouds, What is a Cloud, Whats new in today's Clouds, Cloud computing vs. Distributed computing, Utility computing, Features of today's Clouds: Massive scale, AAS Classification: HaaS, IaaS, PaaS, SaaS, Data-intensive Computing, New Cloud Paradigms, Categories of Clouds: Private clouds, Public clouds

2. Virtualization: What's virtualization, Benefits of Virtualization, Virtualization Models: Bare metal, Hosted hypervisor

3. Types of Virtualization: Processor virtualization, Memory virtualization, Full virtualization, Para virtualization, Device virtualization

4. Hotspot Mitigation for Virtual Machine Migration: Enterprise Data Centers, Data Center Workloads, Provisioning methods, Sandipiper Architecture, Resource provisioning, Black-box approach, Gray-box approach, Live VM Migration Stages, Hotspot Mitigation

Week 2: Network Virtualization and Geo-distributed Clouds

1. Server Virtualization: Methods of virtualization: Using Docker, Using Linux containers, Approaches for Networking of VMs: Hardware approach: Single-root I/O virtualization (SR-IOV), Software approach: Open vSwitch, Mininet and its applications
2. Software Defined Network: Key ideas of SDN, Evolution of SDN, SDN challenges, Multi-tenant Data Centers: The challenges, Network virtualization, Case Study: VL2, NVP
3. Geo-distributed Cloud Data Centers: Inter-Data Center Networking, Data center interconnection techniques: MPLS, Google's B4 and Microsoft's Swan

Week 3: Leader Election in Cloud, Distributed Systems and Industry Systems

1. Leader Election in Rings (Classical Distributed Algorithms): LeLann-Chang-Roberts (LCR) algorithm, The Hirschberg and Sinclair (HS) algorithm
2. Leader Election (Ring LE & Bully LE Algorithm): Leader Election Problem, Ring based leader election, Bully based leader election, Leader Election in Industry Systems: Google's Chubby and Apache Zookeeper
3. Design of Zookeeper: Race condition, Deadlock, Coordination, Zookeeper design goals, Data model, Zookeeper architecture, Sessions, States, Usecases, Operations, Access Control List (ACL), Zookeeper applications: Katta, Yahoo! Message Broker

Week 4: Classical Distributed Algorithms and the Industry Systems

1. Time and Clock Synchronization in Cloud Data Centers: Synchronization in the cloud, Key challenges, Clock Skew, Clock Drift, External and Internal clock synchronization, Christians algorithm, Error bounds, Network time protocol (NTP), Berkley's algorithm, Datacenter time protocol (DTP), Logical (or Lamport) ordering, Lamport timestamps, Vector timestamps
2. Global State and Snapshot Recording Algorithms: Global state, Issues in Recording a Global State, Model of Communication, Snapshot algorithm: Chandy-Lamport Algorithm
3. Distributed Mutual Exclusion: Mutual Exclusion in Cloud, Central algorithm, Ring-based Mutual Exclusion, Lamport's algorithm, Ricart-Agrawala's algorithm, Quorum-based Mutual Exclusion, Maekawa's algorithm, Problem of Deadlocks, Handling Deadlocks, Industry Mutual Exclusion : Chubby

Week 5: Consensus, Paxos and Recovery in Clouds

1. Consensus in Cloud Computing and Paxos: Issues in consensus, Consensus in synchronous and asynchronous system, Paxos Algorithm
2. Byzantine Agreement: Agreement, Faults, Tolerance, Measuring Reliability and Performance, SLIs, SLOs, SLAs, TLAs, Byzantine failure, Byzantine Generals Problem, Lamport-Shostak-Pease Algorithm, Fischer-Lynch-Paterson (FLP) Impossibility
3. Failures & Recovery Approaches in Distributed Systems: Local checkpoint, Consistent states, Interaction with outside world, Messages, Domino effect, Problem of Livelock, Rollback recovery schemes, Checkpointing and Recovery Algorithms: Koo-Toueg Coordinated Checkpointing Algorithm

Week 6: Cloud Storage: Key-value stores/NoSQL

1. Design of Key-Value Stores: Key-value Abstraction, Key-value/NoSQL Data Model, Design of Apache Cassandra, Data Placement Strategies, Snitches, Writes, Bloom Filter, Compaction, Deletes, Read, Membership, CAP Theorem, Eventual Consistency, Consistency levels in Cassandra, Consistency Solutions
2. Design of HBase: What is HBase, HBase Architecture, Components, Data model, Storage Hierarchy, Cross-Datacenter Replication, Auto Sharding and Distribution, Bloom Filter, Fold, Store, and Shift

Week 7: P2P Systems and their use in Industry Systems

1. Peer to Peer Systems in Cloud Computing: Napster, Gnutella, FastTrack, BitTorrent, DHT, Chord, Pastry and Kelips.

Week 8: Cloud Applications: MapReduce, Spark and Apache Kafka

1. MapReduce: Paradigm, Programming Model, Applications, Scheduling, Fault-Tolerance, Implementation Overview, Examples
2. Introduction to Spark: Resilient Distributed Datasets (RDDs), RDD Operations, Spark applications: Page Rank Algorithm, GraphX, GraphX API, GraphX working
3. Introduction to Kafka: What is Kafka, Use cases for Kafka, Data model, Architecture, Types of messaging systems, Importance of brokers



COMPILER DESIGN

PROF. RUPESH NASRE

Department of Computer Science and Engineering
IIT Madras

TYPE OF COURSE : Core | UG

PRE-REQUISITES : Programming and Data Structures, C programming language, along with tools such as lex-yacc/bison

COURSE OUTLINE : The objectives are to teach students a understanding of some of the standard passes in a general purpose compiler and to provide hands-on experience in implementing a compiler for a subset of a high-level language such as C.

ABOUT INSTRUCTOR : Rupesh is an associate professor in the CSE Department at IIT Madras. He completed PhD from IISc Bangalore and Post-Doctoral Fellowship from the University of Texas at Austin. His research focus is in Compilers and Parallelization. He is a recipient of the Young Faculty Recognition Award at IIT Madras, Cray HPC Award, NVIDIA Special Prize for CodeForScience, a winner of the Yahoo! University Hack Day, and holds five US patents. He is the head of the National Supercomputing Mission's Nodal Centre at IITM for Training in HPC and AI.

COURSE PLAN :

Week 1: **Introduction** | **Concepts covered** - Programming languages and compilers, Language Translators

Keywords - Phases of a compiler, Static vs Dynamic contexts, Parameter passing

Week 2: **Lexical Analysis** | **Concepts covered** - Regular Expressions, flex tool, Finite Automata

Keywords - Terminology, Regex, flex tool, Lexical errors, Input buffering, Lookahead, KMP string matching, Regex to DFA conversion

Week 3: **Lexical Analysis, Parsing** | **Concepts covered** - Parse tree, Ambiguity

Keywords - CFG, Parse tree, Precedence, Ambiguity, Sentential forms, Error recovery, if-else ambiguity, Left recursion, Recursive descent parsing

Week 4: **Parsing** | **Concepts covered** - Predictive Parsing, LL(1) Grammars

Keywords - First and Follow, Predictive parsing table, Predictive parsing table, LL(1) grammars, Discussions and doubts clarification

Week 5: **Parsing** | **Concepts covered** - Bottom-up Parsing, Shift-Reduce Parsing

Keywords - SLR parsing, LR(0) automaton, SLR parsing using automaton

Week 6: **Parsing** | **Concepts covered** - SLR(1) Parsing

Keywords - SLR(1) parsing table, SLR(1) parsing algorithm

Week 7: **Parsing** | **Concepts covered** - LR(1) Parsing, LALR Parsing

Keywords - Viable prefixes, LR(1) automaton

Week 8: **Syntax Directed Translation** | **Concepts covered** - SDT, SDD

Keywords - Attributes, S- and L-attributed SDD, Applications, Actions within productions

Week 9: **Intermediate Code Generation** | **Concepts covered** - Syntax Trees and DAGs

Keywords - Code generation for while loop

Week 10: **Intermediate Code Generation** | **Concepts covered** - IR, Three Address Code

Keywords - Discussions and Doubt Clarifications, Static Single Assignment

Week 11: **Intermediate Code Generation** | **Concepts covered** - IR for various language constructs

Keywords - Type expressions, array expressions, boolean expressions, break, continue, switch

Week 12: **Code Generation** | **Concepts covered** - IR and Target Code

Keywords - Instruction Selection, Ordering, Basic Blocks, CFG, x86 Assembly Code

Week 13: **Code Optimization** | **Concepts covered** - Local, Peephole Optimizations, Data Flow Analysis

Keywords - Array References, Register Allocation, Liveness Analysis, Reaching Definitions



COMPUTER INTEGRATED MANUFACTURING

PROF. JANAKARAJAN RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

PROF. AMANDEEP SINGH

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Use of computers in manufacturing in order to design and develop the products has found unprecedented applications. Computer integrated way of manufacturing provides a myriad of benefits such as speed, flexibility, and better control. In this course, Computer Integrated Manufacturing (CIM) approaches are discussed. CAD/CAM tools and their within and between the production systems are presented along with appropriate case studies. Data storage and handling is also the need of contemporary manufacturing systems. This is also catered using software tools. The course is reinforced with the laboratory demonstrations to add a practitioners' touch. Students would develop a prowess to largely plan, design and develop a product and a production system after completing this course

ABOUT INSTRUCTOR :

Prof. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers

Prof. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1: Introduction to Computer Integrated Manufacturing (CIM)

Week 2: Computer Aided Design

Week 3: Computer Aided Manufacturing

Week 4: Computer Numerical Control

Week 5: Computer Aided Process Planning (CAPP)

Week 6: CIM interfaces: CAD vs CAM

Week 7: Data and information in CIM

Week 8: Manufacturing Systems and their design

Week 9: Simulation of Manufacturing Systems

Week 10: Computer Aided Maintenance

Week 11: Computer Integrated Additive Manufacturing

Week 12: Advanced CIM techniques



CONSTRUCTION METHODS AND EQUIPMENT MANAGEMENT

PROF. INDU SIVA RANJANI GANDHI

Department of Civil Engineering

IIT Guwahati

INTENDED AUDIENCE : Post graduate students of Construction Technology and Management

Specialization, Undergraduate students of Civil Engineering , People working in Construction Industry

INDUSTRIES APPLICABLE TO : Larsen and Toubro, Caterpillar, Liebherr, Hyundai Construction Equipment India and other Construction Equipment Companies.

PREREQUISITES : Engineering would be minimum qualification to understand the basics related to this course.

COURSE OUTLINE :

The key element for successful execution of any project is planning, which also includes planning of equipment. Due to recent advancement in mechanization, different models of machines are available in the market for a particular job. Hence the task of selection of right machine for the right job is quite challenging for project planner. Therefore, understanding of machine capabilities is very important for optimal selection and utilization of equipment. This course provides comprehensive information on guidelines for selection of equipment, estimation of cost and productivity of various equipment and determination of optimum replacement time of equipment. Knowledge on estimation of cost of equipment is very important, as accurate information on equipment cost is needed for preparation of bids. Further, a deep insight into excavation, pile driving methods, cranes and concreting equipment is provided, the information on which is very much essential for people working in construction industry

ABOUT INSTRUCTOR :

Prof. G. Indu Siva Ranjani holds a PhD degree in Civil Engineering (Building Technology and Construction Management) from Indian Institute of Technology Madras, India. She is recipient of Gold medal and Shree Gayathri Devi Award for securing highest CGPA in the Ph.D. Civil Engineering programme in July 2011 at IIT Madras. Presently she is working as Assistant Professor at Indian Institute of technology Guwahati, India. She has handled courses at IIT Guwahati related to both Construction Management and Construction materials. Some of the management related courses handled by her, to be mentioned are Construction methods and Equipment management, Quality and Safety management and Construction Technology and Management. Similarly, in materials domain, she has handled courses on Construction materials and Advanced Concrete Technology. Her major research interests are Lightweight concrete, sustainable construction materials and energy efficient structures. She has also proposed new materials for the production of foamed concrete. Her work has been published in peer reviewed journals and cited more than 500 times in leading scientific journals throughout the world. She has so far guided 21 MTechs, & 2 Ph.D. projects.

COURSE PLAN :

Week 1: Module 1: Introduction to course and Planning Process of Equipment

Lecture 1: Planning process of equipment

- Factors affecting equipment selection, Planning equipment utilization, Equipment utilization chart.

Module 2: Cost of Owning and Operating Construction Equipment

Lecture 2: Estimation of Ownership cost (Average Annual Investment method)

- Elements of ownership cost, Depreciation accounting methods, Cost Estimation using Average Annual Investment method.

Week 2: Module 2: Cost of Owning and Operating Construction Equipment

Lecture 3: Estimation of Ownership cost (Time value method)

- Use of compounding factors in Equipment cost estimation based on time value method.

Lecture 4: Operating cost of Equipment

- Operating cost components, Illustrations on estimation of operating cost.

Lecture 5: Equipment cost estimation

- Caterpillar & Peurifoy method – Illustrations on use of Caterpillar method and Peurifoy method for estimation of total equipment cost.

Week 3: Module 3: Equipment Life and Replacement Analysis

Lecture 6: Equipment Life and Replacement Analysis (Part 1)

- Physical life, Profit life, Economic life, Illustrations on determination of economic life of equipment.

Lecture 7: Equipment Life and Replacement Analysis (Part 2)

- Equipment Replacement analysis- Intuitive method, Minimum cost method, Maximum profit method.

Lecture 8: Equipment Life and Replacement Analysis (Part 3)

- Determination of economic life based on equivalent annual cost (using time value concept).

Week 4: Module 4: Engineering Fundamentals of Moving Earth

Lecture 9: Engineering Fundamentals of Moving Earth

- Machine Performance-Required power, Available power, Usable power, Rolling resistance, tractive force, co-efficient of traction, Effect of grade on tractive effort, Effect of altitude on performance of IC engines, Performance chart, ways to define payload of equipment.

Module 5: Earthmoving and Excavating equipment

Lecture 10: Bull Dozers

- Bull Dozers-Types of dozer blades, blade adjustments, Blade performance, production estimation.

Lecture 11: Scrapers (Part 1)

- Scrapers, Scraper operation, types of scraper, Components of production cycle of scraper and pusher.

Lecture 12: Scrapers (Part 2)

- Illustrations on production estimation of scraper and balancing interdependent machines.

Week 5: Module 5: Earthmoving and Excavating equipment

Lecture 13: Front End loaders

- Front-End loaders –loader attachments, productivity estimation.

Lecture 14: Excavators

- Excavators-Front shovels and backhoes, operation, factors affecting selection, production estimation.

Lecture 15: Trucks

- Production cycle, cycle time estimation, Productivity of trucks, balancing interdependent machines.

Week 6: Module 6: Piles and Pile driving equipment

Lecture 16: Piles and Pile driving equipment (Part 1)

- Pile types: Precast and cast in situ piles, pile hammers, principle of pile hammer, factors affecting pile hammer selection.

Lecture 17: Piles and Pile driving equipment (Part 2)

- Types of pile hammer: Drop hammer, Single acting and double acting steam hammers, Diesel hammers, Vibratory pile drivers.

Week 7: Module 7: Lifting equipment

Lecture 18: Cranes (Part 1)

- Cranes, Crane motions, Principles of lifting mechanism of crane, types of cranes-lattice boom crawler crane, lattice boom truck mounted cranes, telescopic boom crane.

Lecture 19: Cranes (Part 2)

- Types of cranes-Tower cranes, Factors affecting lifting capacity of crane, Range diagram.

Week 8: Module 8: Concreting equipment

Lecture 20: Concreting equipment (Part 1)

- Steps in concrete making process, types of concrete mixer machines.

Lecture 21: Concreting equipment (Part 2) & Conclusion

- Methods of handling and transporting concrete, Consolidation of concrete, Methods of finishing and curing of concrete.



DAIRY AND FOOD PROCESS AND PRODUCTS TECHNOLOGY

PROF. TRIDIB KUMAR GOSWAMI

Department of Agricultural and Food Engineering
IIT Kharagpur

INTENDED AUDIENCE : Agricultural Engineering, Food Technology, Food Engineering, Chemical Engineering, Biotechnological Engineering, Thermal Engineering, Biotechnology

INDUSTRIES APPLICABLE TO : Any Processing Industry such as Britannia, ITC, Hindustan Lever, Mother Dairy, Amul, etc.

COURSE OUTLINE :

This course will cover basics of dairy (liquid food) food processing and preservation technologies required in any dairy and food processing industries. The basic knowledge on dairy food processing is intermingled with most of the unit operations at some or other stage of processing. Since, this basic aspect of food processing and preservations not taught in most of the Agricultural engineering institutions elaborately, a comprehension of these aspects of processing and preservation will enrich the knowledge base of the students in general.

ABOUT INSTRUCTOR :

Prof. Tridib Kumar Goswami, a NAAS, ISAE, IE, AABS Fellow, did his B.Sc. in Chemistry (Hons) from University of Calcutta, B.Tech. in Food Technology and Biochemical Engineering from Jadavpur University, Ph.D. from IIT Kharagpur. After serving Kwality Ice Cream, Bombay for 1 years, he joined IIT Kharagpur in 1989 and is still continuing as a Professor. He has earned 5 Indian Patents, published 104 papers in peer reviewed reputed journals, 55 conference proceedings. He has written 4 books and 14 book chapters published by International publishers. He has travelled around the world for presenting papers and was specially invited by Jeonbuk National University, Korea with full sponsorship in 2009. He has guided 14 Ph.D., out of which 3 theses have been awarded the prestigious Jawaharlal Nehru Award offered by ICAR. One of his papers was awarded the prestigious N.N. Mohan Memorial Award for 2009 conferred by AIFPA, New Delhi for Best Paper of the year. He has also received several National and International awards. He has completed several sponsored research & consultancy projects as PI and co-PI. He is the first faculty from Agricultural Engineering discipline in India to contribute to the National program on technology enhanced learning.

COURSE PLAN :

Week 1 : Basic principles and methods of food processing and preservation. Emerging Technologies in food processing. Food additives and preservatives.

Week 2 : Food laws and standards. Effect of processing on acceptability and nutritive value of food.

Week 3 : Physico-chemical properties and structure of milk and milk constituents.

Week 4 : Chemical and microbial spoilage of milk and milk products; Fluid milk Processing, packaging and distribution.

Week 5 : Common dairy processes – cream separation (standardization), pasteurization, sterilization and Homogenization.

Week 6 : Process technology for manufacture of evaporated milk, condensed milk, dried milk, malted milk, infant and baby foods, ice-cream, cheese, butter, fermented milk and indigenous dairy products.

Week 7 : Methods and procedures for sampling and testing of milk and milk products. Laws and standards for milk and milk products.

Week 8 : Technological processes for industrially manufactured foods of commercial importance, from plant and animal origin.

Week 9 : Cereals, vegetables, fruits, meats, poultry and egg products; Bakery, pasta and confectionary products, ready to eat foods, fermented foods, alcoholic and non-alcoholic Beverages, tea, coffee and cocoa, fabricated foods.

Week 10 : Packaging materials; Characteristics, properties and their design. Packaging requirement for Different processed and unprocessed foods.

Week 11 : Working Principles of various type of fillers : form-fill-seal machine.

Week 12 : Gas packaging and modified atmosphere Package design. Shelf life prediction of foods in packages. Quality control in Food packaging. Product safety and packaging regulations.



DATA ANALYTICS WITH PYTHON

PROF. A RAMESH

Department of Management Studies
IIT Roorkee

INTENDED AUDIENCE : Management, Industrial Engineering and Computer Science Engineering Students

INDUSTRIES APPLICABLE TO : Any analytics company

COURSE OUTLINE :

We are looking forward to sharing many exciting stories and examples of analytics with all of you using python programming language. This course includes examples of analytics in a wide variety of industries, and we hope that students will learn how you can use analytics in their career and life. One of the most important aspects of this course is that you, the student, are getting hands-on experience creating analytics models; we, the course team, urge you to participate in the discussion forums and to use all the tools available to you while you are in the course!

ABOUT INSTRUCTOR :

Prof. Ramesh Anbanandam graduated in Production Engineering from Madras University, Chennai. He did his post-graduation from National Institute of Technology, Trichy. He later earned his Ph.D. in Supply Chain Management from Indian Institute of Technology Delhi. His professional interest includes Humanitarian Supply Chain Management, Operations Management, Operations Research, Healthcare Waste Management, Sustainable Multi-model and Freight Transportation, Transportation Asset Management and Advanced Data Analytics using Python and R-programming. He has published various research articles in reputed journals. He was also awarded Emerald Literati Award for Excellence under "Highly Commended Research Paper in the Year 2011 and 2016" in the field of Supply Chain Management.

COURSE PLAN :

Week 1: Introduction to data analytics and Python fundamentals

Week 2: Introduction to probability

Week 3: Sampling and sampling distributions

Week 4: Hypothesis testing

Week 5: Two sample testing and introduction to ANOVA

Week 6: Two way ANOVA and linear regression

Week 7: Linear regression and multiple regression

Week 8: Concepts of MLE and Logistic regression

Week 9: ROC and Regression Analysis Model Building

Week 10: χ^2 Test and introduction to cluster analysis

Week 11: Clustering analysis

Week 12: Classification and Regression Trees (CART)



DATA BASE MANAGEMENT SYSTEM

PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SAMIRAN CHATTOPADHYAY

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Procedural and / or Object-Oriented Programming (C / C++ / Java / Python), Data Structures, Algorithms

INTENDED AUDIENCE : Students from all disciplines can enroll for this course.

INDUSTRIES APPLICABLE TO : DBMS is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems, data mining, machine learning) have a need for the same. These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

COURSE OUTLINE :

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. Consequently, Oracle, Microsoft SQL Server, Sybase etc. have emerged as leading commercial systems while MySQL, PostgreSQL etc. lead in open source and free domain.

While DBMS's differ in the details, they share a common set of models, design paradigms and a Structured Query Language (SQL). In this background the course examines data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation. More specifically, the course introduces relational data models; entity-relationship modeling, SQL, data normalization, and database design. Further it introduces query coding practices using MySQL (or any other open system) through various assignments. Design of simple multi-tier client / server architectures based and Web-based database applications is also introduced.

ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Prof. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (<https://www.facebook.com/t10kt.algorithms/>) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

Prof. Samiran Chattopadhyay obtained his B Tech and M Tech degree in 1987 and 1989 respectively from IIT Kharagpur. He obtained his PhD degree from Jadavpur University in 1993. He served as a faculty in the Department of Computer Science and Engineering, Jadavpur University from 1989 to 1993. In 1993, he moved to industry and joined back the same department in Jadavpur University as an Associate Professor in 1997. Since 2001, he is a Professor of Information Technology in Jadavpur University.

Prof. Chattopadhyay is also a visiting fellow of the University of Northumbria, Newcastle upon Tyne UK. He was an adjunct faculty at IIT Kharagpur for the Distributed Systems course and a visiting faculty member for the MTech course by IIT Kharagpur which was offered in distance learning mode.

Dr. Chattopadhyay has more than two decades of experience of serving reputed Industry houses including Mindware, Computer Associates TCG Software, Interra Systems India Ltd. He is also a project consultant of the prestigious National Digital Library Mission of Government of India.

Prof. Chattopadhyay has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Ad hoc Wireless Networks, Cloud Computing. Dr. Chattopadhyay has been a co-faculty in Database Management Systems in NPTEL-NOC.

Prof. Chattopadhyay has published over 60 technical papers in international journals in the areas of Wireless Networks, Network Security, Machine learning applications. He has co-authored a research monograph titled 'Digital Geometry in Image Processing', a textbook titled 'Data Structures through C' and 'Big Data in e-Healthcare'. His current research interests include Network Security, Machine learning, Wireless network and Pervasive computing.

COURSE PLAN :

Week 1: Course Overview, Introduction to RDBMS

Week 2: Structured Query Language (SQL)

Week 3: Relational Algebra, Entity-Relationship Model

Week 4: Relational Database Design

Week 5: Application Development, Case Studies, Storage and File Structure

Week 6: Indexing and Hashing, Query Processing

Week 7: Query Optimization, Transactions (Serializability and Recoverability)

Week 8: Concurrency Control, Recovery Systems, Course Summarization



DATA SCIENCE FOR ENGINEERS

PROF. RAGUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PROF. SHANKAR NARASIMHAN

Department Of Chemical Engineering
IIT Madras

PRE-REQUISITES : 10 hrs of pre-course material will be provided, learners need to practise this to be ready to take the course.

INTENDED AUDIENCE : Any interested learner

INDUSTRY SUPPORT : HONEYWELL, ABB, FORD, GYAN DATA PVT. LTD

COURSE OUTLINE :

Learning Objectives :

- Introduce R as a programming language
- Introduce the mathematical foundations required for data science
- Introduce the first level data science algorithms
- Introduce a data analytics problem solving framework
- Introduce a practical capstone case study

Learning Outcomes:

- Describe a flow process for data science problems (Remembering)
- Classify data science problems into standard typology (Comprehension)
- Develop R codes for data science solutions (Application)
- Correlate results to the solution approach followed (Analysis)
- Assess the solution approach (Evaluation)
- Construct use cases to validate approach and identify modifications required (Creating)
-

ABOUT INSTRUCTOR :

Prior to joining IIT Madras as a professor, **Prof.Rengaswamy** was a professor of Chemical Engineering and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

Prof.Shankar Narasimhan is currently a professor in the department of Chemical Engineering at IIT Madras. His major research interests are in the areas of data mining, process design and optimization, fault detection and diagnosis and fault tolerant control. He has co-authored several important papers and a book titled Data Reconciliation and Gross Error Detection: An Intelligent Use of Process Data which has received critical appreciation in India and abroad.

COURSE PLAN :

Week 1: Course philosophy and introduction to R

Week 2: Linear algebra for data science

1. Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse)
2. Geometric view - vectors, distance, projections, eigenvalue decomposition

Week 3: Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)

Week 4: Optimization

Week 5: 1. Optimization

2. Typology of data science problems and a solution framework

Week 6: 1. Simple linear regression and verifying assumptions used in linear regression

2. Multivariate linear regression, model assessment, assessing importance of different variables, subset selection

Week 7: Classification using logistic regression

Week 8: Classification using kNN and k-means clustering



DATA STRUCTURE AND ALGORITHMS USING JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++/Java, data structures and algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines, namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. For developing large software, software developers should have enough proficiency of data structures and algorithms. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of data structures and algorithms and how the same can be implemented using Java programming language. The participants of the proposed course will be able to improve their skills, to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Dr. Samanta currently works as a faculty member at the Department of Computer Science & Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: 1D array, list and vector, 2D matrices and tables of objects

Week 2: Java implementation of 1D and 2D arrays and its operations

Week 3: Linked lists and its various operations, stack and queue

Week 4: Java implementation of linked lists, stack and queue

Week 5: Binary trees: Representation and operations. Variations of binary tree: Binary search tree, Height balanced search tree, Heap tree

Week 6: Java implementation of binary trees and its variations

Week 7: Graph : Structure, representation and operations

Week 8: Java implementations of graph data structures

Week 9: Algorithms (Part-I): Searching and sorting algorithms

Week 10: Java implementation of Part-I algorithms

Week 11: Algorithms (Part-II): Greedy algorithms, shortest path algorithms

Week 12: Java implementation of Part-II algorithms



DEMYSTIFYING NETWORKING

PROF. SRIDHAR IYER

Department of Computer Science and Engineering
IIT Bombay

PROF. ASHUTOSH RAINA

Department of Computer Science and Engineering
IIT Bombay

INTENDED AUDIENCE : Computer Networking

INDUSTRIES APPLICABLE TO : Networking, Security, Troubleshooting

COURSE OUTLINE :

This course will provide students with an overview of networking concepts and technologies. It is meant as a primer for non-majors, i.e., for students who don't have networking as a core course in their curriculum. After this primer, students may choose to take other networking courses for delving deeper into specific technologies.

ABOUT INSTRUCTOR :

Prof. Sridhar Iyer is a faculty member in the Inter-Disciplinary Program in Educational Technology, and Department of Computer Science and Engineering at IIT Bombay. His current research interests include: Technology enhanced learning environments for thinking skills, Pedagogies for effective use of educational technologies, development of ICT tools for educational applications, and Computer science education research. Sridhar Iyer received his BTech, MTech and PhD from the Dept of Computer Science & Engg. at IIT Bombay.

Prof. Ashutosh Raina is Researcher with the IDP in Educational Technology at IIT Bombay. His PhD in the Interdisciplinary program in Educational Technology at IIT Bombay focused on nurturing tinkering as a strategy for problem-solving in engineering design. His research interests also include the role of situated learning and analogies in problem-solving, specifically in computer science. He has experience designing active learning-based pedagogies and methods of teaching online, including a range of skills for creating and managing MOOCs. He has mentored in several teacher training workshops and FDPs for Institutions and public sector companies.

COURSE PLAN :

Week 1: Layers of Computer Networks and Network Addressing

Week 2: Routing

Week 3: Transport and Application Layers

Week 4: Introduction to Security and Troubleshooting



DESIGN THINKING - A PRIMER

PROF. ASHWIN MAHALINGAM

Department of Civil Engineering
IIT Madras

PROF. BALA RAMADURAI

Department of Management Studies
IIT Madras

INTENDED AUDIENCE : General

INDUSTRIES APPLICABLE TO : Many industries and institute recognize the need for design thinking -
e.g., ICT, manufacturing, sales, marketing

COURSE OUTLINE :

Design thinking is a systematic method of solving problems. This method is unique that it starts and ends with humans. The design thinkers start by observing, interviewing or just plain experiencing a situation. Then, they proceed to improve the situation of the humans by solving problems for them.

ABOUT INSTRUCTOR :

Prof. Ashwin Mahalingam joined the faculty in the Building Technology and Construction Management division of the Civil engineering department at IIT-Madras in 2006. Ashwin received his B.Tech in Civil engineering from IIT-Madras and then proceeded to Stanford University for a Masters in Construction Engineering and Management. He then helped start up an internet based company in the USA called All Star Fleet, aimed at providing asset management services for construction companies. Following this he returned to Stanford University to pursue a PhD in the area of Infrastructure Project Management. Ashwin's research interests are in the areas of Public Private Partnerships (PPP) in Infrastructure, the management and governance of large engineering projects and the use of digital technologies in construction. Ashwin's current research focuses on institutional strengthening and post-award governance of PPP projects in India. Ashwin is also a co-founder of Okapi Advisory Services Pvt. Ltd and serves as a Director on the Board.

Prof. Bala Ramadurai is an independent innovation consultant and professor. He has 3 patents to his credit and 10+ publications in international research journals. He co-founded TRIZ Innovation India (<http://trizindia.org>) and is an Adjunct Professor at Symbiosis Institute of Business Management, India. He has a PhD from Arizona State University, USA, and a B.Tech from IIT Madras, India.

COURSE PLAN :

Week 1 : Introduction to Design Thinking

Week 2 : Empathize Phase: Customer Journey Mapping

Week 3 : Analyze Phase: 5-Whys and How might we...

Week 4 : Solve Phase: Ideation: Free Brainstorming & Make/Test Phase: Prototype



DIGITAL CIRCUITS

PROF. SANTANU CHATTOPADHYAY

Department of Electronics and Electrical Communication Engineering,
IIT Kharagpur.

INTENDED AUDIENCE : All Engineering Student/Faculty

PRE-REQUISITES : Basic Electronics

INDUSTRIES APPLICABLE TO : Companies involved in development digital products

COURSE OUTLINE :

Digital circuits are part of any electronic design today. This also happens to be one of the core subjects for the undergraduate students in Electronics, Electrical and Computer Engineering. It forms the basis of many of the next level courses. The proposed course on digital circuits will cover all the fundamental concepts in digital design. It will primarily focus on the prescribed GATE syllabus for Electronics and Communication Engineering (ECE) specialization. The course will start with the representations of numbers – different number systems and conversion between them, representation of integer and real numbers etc. This will be followed by combinational and sequential circuit design techniques. Data converters and semiconductor memories will be covered. Microprocessor 8085 will be discussed as a complete digital system example. Designed primarily as a single course covering the digital circuits portion of GATE syllabus, the course will also be helpful for any other aspirant willing to learn digital electronics principles comprehensively in today's perspective.

ABOUT INSTRUCTOR :

Prof. Santanu Chattopadhyay received his BE degree in Computer Science and Technology from Calcutta University (B.E. College) in 1990. He received M.Tech in Computer and Information Technology and PhD in Computer Science and Engineering from Indian Institute of Technology Kharagpur in 1992 and 1996, respectively. He is currently a Professor in the Department of Electronics and Electrical Communication Engineering, IIT Kharagpur. Prior to this, he had been a faculty member in the IEST Sibpur and IIT Guwahati in the departments of Computer Science and Engineering. In both these places he has taught the subject of Compiler Design several times. His research interests include Digital Design, Embedded Systems, System-on-Chip (SoC) and Network-on-Chip (NoC) Design and Test, Power- and Thermal-aware Testing of VLSI Circuits and Systems. He has published more than 150 papers in reputed international journals and conferences. He has published several text and reference books on Compiler Design, Embedded Systems and other related areas. He is a senior member of the IEEE and an Associate Editor of IET Circuits Devices and Systems journal.

COURSE PLAN :

Week 01 : Introduction, Number System

Week 02 : Boolean Algebra

Week 03 : Combinational function minimization – K Map, Boolean identities

Week 04 : Logic Gates

Week 05 : Arithmetic circuits, Code converters

Week 06 : Multiplexers, Decoders, PLA

Week 07 : Sequential Circuits – Latches and Flip-flops

Week 08 : Counters, Shift Registers, Finite State Machines

Week 09 : Data Converters – Sample and hold circuits, ADCs, DACs

Week 10 : Semiconductor Memories – ROM, SRAM, DRAM

Week 11: Microprocessor 8085 – Part I

Week 12 : Microprocessor 8085 – Part II



ELECTROCHEMICAL TECHNOLOGY IN POLLUTION CONTROL

PROF. J. R. MUDAKAVI

Department of Chemical Engineering
IISc Bangalore

PRE-REQUISITES : 10 +2 + 3 years of BE / BSc Basic knowledge of differential calculus and integration

INTENDED AUDIENCE : Chemists and Chemical Engineers, Environmental Engineers, Environmental Scientists, Civil Engineers, Pollution Control Administrators, B.Sc, M.Sc and PhD students.

INDUSTRIES APPLICABLE TO : Chemical industries, Pollution Control

COURSE OUTLINE :

Electroanalytical techniques have assumed great importance in pollution monitoring of chemical species in the last 20 years. Electrochemical sensors including ion selective electrodes are employed to detect the pollution levels in all public spaces. They also find extensive applications in medical diagnosis, industrial process monitoring, communication industry etc. Fuel cells and battery technology are the energy sources of the future. Industrial wastes generated from electrochemical processes are one of the most hazardous wastes which need to be effectively managed. The course aims to introduce the fundamental principles of electrochemistry for routine and non-routine analysis, electrochemical processes used in the industry, battery and fuel cell technologies and recent advances in hazardous electrochemical waste management including concepts of zero liquid discharge.

ABOUT INSTRUCTOR :

Prof. J.R Mudakavi is a former faculty of Chemical Engineering Department in Indian Institute of Science, Bangalore. He has taught "Modern Instrumental Methods of analysis and Pollution Control" for 36 years. He is the author of 2 books on Air Pollution and Hazardous Waste management. He has published more than 100 papers in National and International Journals, conferences, Symposia etc. He is a member of several expert committees such as CSIR, DST, MOEF, KSPCB etc., He is a popular science writer and lecturer and environmentalist.

COURSE PLAN :

Week 1: Atomic and Molecular structure

Week 2: Properties of solutions

Week 3: Electrochemical methods-1

Week 4: Electrochemical methods-2

Week 5: Electrochemical methods-3

Week 6: Ion selective electrodes and Electrochemical sensors

Week 7: Process waste handling and Electroplating

Week 8: Batteries and fuel cells and ZLD



ELECTRONIC WASTE MANAGEMENT – ISSUES AND CHALLENGES

PROF. BRAJESH KUMAR DUBEY

Department of Civil Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Elective | PG

COURSE DURATION : 4 weeks (24 Jan' 22-18 Feb' 22)

EXAM DATE : 27 March 2022

PRE-REQUISITES : Environmental Sciences, Introduction to Environmental Engineering

INTENDED AUDIENCE : Disciplines of Engineering, Science, Humanities and Management

INDUSTRIES APPLICABLE TO : E Parisaraa, Ecoreco Recycling, Earth Sense, Attero Recycling, EWRI, WEEE Recycle, J. S. Pigments Limited. In addition ULBs across the country will be interested in this course, so as professionals from SPCB and CPCB.

COURSE OUTLINE :

This course will discuss the overall scenario of E-Waste management in India in comparison with other countries around the globe. At first, the present scenario of E-Waste management in India will be discussed along the role of various stakeholders. Then, the effects of recycling and management of Electronic Waste on human health, environment and society will also be presented. This will be followed by the risk assessment owing to pollutants released from E-Waste recycling in soil, air and water. The possible option of extraction of Rare-Earth Minerals will also be discussed in this course. The E-Waste management Rules of India and around the World will be compared. Finally a Life-Cycle Analysis approach will be employed for a possible sustainable solution of E-Waste Management for cutting the ill-effects of informal recycling.

ABOUT INSTRUCTOR :

Prof. Brajesh Kr. Dubey has his Bachelors Degree in Civil Engineering (Hons) from Indian Institute of Technology (IIT) Kharagpur, India and PhD in Environmental Engineering Sciences, University of Florida, Gainesville, Florida, USA. He is presently Associate Professor (Integrated Waste Management and Sustainable Engineering) in the Division of Environmental Engineering and Management at Indian Institute of Technology (IIT), Kharagpur, India. Dr. Dubey has more than 17 years of research, teaching, training and industrial outreach experience in the areas of Integrated Solid and Hazardous Waste Management, and Sustainable Engineering and Application of Life Cycle Assessment techniques. He also works in the area of Life Cycle Analysis and Sustainable Engineering. He has been teaching courses in the area of Solid Waste Management, Hazardous Waste Management. Dr. Dubey has authored/co-authored more than 200 publications in his area of expertise and have presented at several national and international conferences. He has worked as Waste Management Expert for UN agencies and World Bank.

COURSE PLAN :

Week 1: Overview of the course

Week 2: Exposure pathway of pollutants emitted from Recycling of E-Waste

Week 3: E-Waste Management Rules of India (2011 and 2016 Rules)

Week 4: E-waste Management: Case Studies and Unique Initiatives from around the World



EMOTIONAL INTELLIGENCE

PROF. RABINDRA KUMAR PRADHAN

Department of Humanities and Social Sciences

IIT Kharagpur

INTENDED AUDIENCE : Engineering, Management, Social Sciences and Law students

INDUSTRIES APPLICABLE TO : Human resource management division, training & development division of both manufacturing and service industries, MBA and HRM students

COURSE OUTLINE :

"Intelligence quotient (IQ) gets you hired but emotional quotient (EQ) gets you promoted". This popular quote by Times magazine during late nineties has made the concept of emotional intelligence more popular among people by highlighting its multiple implications and applications. The uses and utility of emotional intelligence at home, school and workplace have benefited thousands in many disciplines. This course is designed to sensitize the participants about the concept, theory and applications of emotional intelligence. The participants will get to know the added advantage of EQ the software of the brain over the hardware (IQ). This programme will also explore how our hearts rule over our heads for creative creation. It will also focus on how various principles of emotional intelligence guide us in different contexts of life. The awareness about the credo of emotional intelligence will develop insights into self-regulation and realization of one's optimum potentials for better performance. The participants will come to know about many unknowns of life, which will further help them to enhance their awareness to be effective on their roles. The course will offer useful lessons with the help of practical exercises, games, audio-visual instruments, case studies, classroom interaction to show the road map how to foster emotional intelligence in organisation for achieving health, happiness and optimal performance at work.

ABOUT INSTRUCTOR :

Prof. Rabindra Kumar Pradhan is currently working as associate professor in the department of humanities and social sciences, Indian Institute of Technology Kharagpur. He is currently working in diverse areas of behavioral sciences and human resource management. He is actively involved in teaching, training & research in the fields of positive psychology, industrial and organizational psychology, human resource development and management, and organizational behavior. He has 18 years of experience in teaching, research and training. He has published 02 books on emotional intelligence, 01 book on human resource management and 01 book on human development through training. He has also published more than 70 journal articles and 22 book chapters. His research papers/articles have been published in international journal Emerald Insights, Inderscience Publishers, Sage, Springer, Taylor & Francis, etc. Recently, Dr. Pradhan has been awarded with the "best trainer award-2012" by ISTD, Hyderabad and "best teacher award-2013" by ISTD, Kolkata for outstanding contribution in training & HRD. Some of his research papers have been awarded as "best paper" in ICOM-2015, Abu Dhabi and IBRC-2015, India.

COURSE PLAN :

Week 1: Introduction to emotion, intelligence & wisdom

Week 2: Concept, theory, measurement and applications of intelligence

Week 3: Emotional intelligence: concept, theory and measurements

Week 4: Correlates of emotional intelligence

Week 5: Emotional intelligence, culture, schooling and happiness

Week 6: For enhancing emotional intelligence EQ mapping

Week 7: Managing stress, suicide prevention, through emotional intelligence, spirituality and meditation

Week 8: Application of emotional intelligence at family, school and workplace



ENHANCING SOFT SKILLS AND PERSONALITY

PROF.T. RAVICHANDRAN

Department of Humanities and Social Sciences
IIT Kanpur

INTENDED AUDIENCE : Students, Teachers, Professionals, Trainers, Leaders, Employers

INDUSTRIES APPLICABLE TO : All industry/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

COURSE OUTLINE :

The course aims to cause an enhanced awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfilment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The focus of this course is on interpersonal and management skills. It has been approved for "Faculty Development Programme" by AICTE.

ABOUT INSTRUCTOR :

Prof. T. Ravichandran is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad.

COURSE PLAN :

Week 1 : Highlights of Developing Soft Skills and Personality Course-1-24 ; Highlights of Developing Soft Skills and Personality Course-25-48 ; Definitions and Types of Mindset ; Learning Mindsets ; Secrets of Developing Growth Mindsets

Week 2 : Importance of Time and Understanding Perceptions of Time ; Using Time Efficiently ; Understanding Procrastination ; Overcoming Procrastination ; Don't Say "Yes" to Make Others Happy!

Week 3 : Types of People ; How to Say "No" ; Controlling Anger ; Gaining Power from Positive Thinking-1 ; Gaining Power from Positive Thinking-2

Week 4 : What Makes Others Dislike You? ; What Makes Others Like You?-1 ; What Makes Others Like You?-2 ; Being Attractive-1 ; Being Attractive-2

Week 5 : Common Errors-1 ; Common Errors-2 ; Common Errors-3 ; Common Errors-4 ; Common Errors-5

Week 6 : Humour in Communication ; Humour in the Workplace ; Function of Humour in the Workplace ; Money and Personality ; Managing Money

Week 7 : Health and Personality ; Managing Health-1: Importance of Exercise ; Managing Health-2: Diet and Sleep ; Love and Personality ; Managing Love

Week 8 : Ethics and Etiquette ; Business Etiquette ; Managing Mind and Memory ; Improving Memory ; Care for Environment ; Highlights of the Course



ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

PROF. ANJALI PAL

Department of Civil Engineering
IIT Kharagpur

PROF. SUDHA GOEL

Department of Civil Engineering
IIT Kharagpur

TYPE OF COURSE	: Rerun Elective UG/PG
COURSE DURATION	: 12 weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE	: 24 Apr' 2022

PRE-REQUISITES : Basic chemistry - Class XII

INTENDED AUDIENCE : Masters degree students of any of the Civil Engineering, Chemical Engineering Environmental Engineering, Mining Engineering, Geology and Geophysics, and Bioengineering/Biotechnology

INDUSTRIES APPLICABLE TO : Environmental consulting firms, Coal India, Thermal power plants

COURSE OUTLINE :

The objective of the course is to provide students with basic concepts from environmental chemistry and microbiology for understanding and solving environmental problems. Major topics that will be covered in environmental chemistry are: review of basic concepts in chemistry, concept of chemical equilibria, equilibrium constants and activity, reaction kinetics, acid and basis, polyprotic acids and bases, acidity, alkalinity, carbonate system, pH-Ct, buffers, and solubility reactions, nuclear chemistry, nitrogen chemistry and chlorination. Major topics that will be covered in environmental microbiology are: Introduction, the bacteria, the fungi, the algae, protozoa and other higher forms, viruses, pathogens and disease, microbial growth and enumeration, control of microorganisms, microbial diversity and metabolic pathways for remediating contaminated water, solid and hazardous waste, and soil.

ABOUT INSTRUCTOR :

Prof. Anjali Pal did her M.Sc & PhD from Calcutta University in Chemistry and at present teaching as a full professor in the Department of Civil Engineering, Indian Institute of Technology, Kharagpur. Prof. Pal is actively engaged in teaching and research in the field of Environmental Engineering and Science. She has published more than 215 research papers and received International Hall of Fame award (USA), R & D 100 award (USA) for her contribution in the field of pollution monitoring. Her Convention Award from the Indian Chemical Society is for her independent contribution to organic chemistry. Her research interest includes adsorption, advanced oxidation processes (AOPs), catalysis and spectroscopy. She has developed a number of new methods for trace detection / determination of pollutants. She has visited many countries like USA, UK, Japan, France, Taiwan etc. as a visiting professor.

Prof. Sudha Goel did her B.E. (1990) in Environmental Engineering from L.D. College of Engineering, Gujarat University, Ahmedabad and M.S.E. (1992) and Ph.D. (1997) in Environmental Engineering from The Johns Hopkins University (JHU), Baltimore, US. She is currently Associate Professor, Department of Civil Engineering and School of Environmental Science and Engineering, IIT Kharagpur. She has been teaching Environmental Microbiology and some aspects of Environmental chemistry regularly since 2004. Her research interests include Water quality and treatment, and Solid and Hazardous Waste Management. She developed a web-based course 'Water and Wastewater Engineering' and wrote a textbook of the same name. She has several publications, taught several courses, and guided students at all levels in their research work.

COURSE PLAN :

Week 1: Concepts of acids, bases and salts, strengths of acids and bases, buffers, acid-base indicators, choice of indicators

Week 2: Concept of chemical equilibrium, solubility and solubility product, activity, Le Chatelier principle

Week 3: Reaction kinetics, rate and order of a reaction, determination of order

Week 4: Reaction mechanism, rate determining step, catalysts, activation energy

Week 5: Radioactivity and nuclear chemistry

Week 6: Nitrogen chemistry and chlorination

Week 7: Introduction and overview of environmental applications; major groups of microbes: bacteria, fungi, algae, protozoa and virus.

Week 8: Cell chemistry, biology and microscopy

Week 9: Microbial Metabolism

Week 10: Microbial Growth and Control

Week 11: Pathogens and diseases, metabolic diversity-1

Week 12: Metabolic Diversity-2 and Biogeochemical Cycles



EXPERIMENTAL STRESS ANALYSIS

PROF. K. RAMESH

Department of Applied Mechanics
IIT Madras

PRE-REQUISITES : Basic course on Strength of Materials. Course on Theory of Elasticity desirable

INTENDED AUDIENCE : Students in Engineering Colleges and working professionals in similar areas

INDUSTRIES APPLICABLE TO : HAL, GE, GM, NAL, DMRL, DRDO, BEML, Mahindra&Mahindra, Tata Motors, L&T, VSSC, Defense and Atomic energy Laboratories

COURSE OUTLINE :

The course covers the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity and strain gauges and also a brief introduction to the emerging techniques like digital image correlation. In addition it also provides the fundamental aspects of six different experimental techniques such as Moire, Brittle Coatings, Holography, Speckle Methods, Thermoelastic Stress Analysis and Caustics.

ABOUT INSTRUCTOR :

Prof. K. Ramesh is currently a Senior Professor at the Department of Applied Mechanics, IIT Madras; as its Chairman during (2005-2009) and formerly a Professor at the Department of Mechanical Engineering, IIT Kanpur. He received his undergraduate degree in Mechanical Engineering from the Regional Engineering College, Trichy (now NIT, Trichy), Postgraduate degree from the Indian Institute of Science, Bangalore and the Doctoral Degree from the Indian Institute of Technology Madras. He has made significant contributions to the advancement of Digital Photoelasticity. This has resulted in a Monograph on Digital Photoelasticity Advanced Techniques and Applications (2000), Springer, a chapter on Photoelasticity in the Springer Handbook of Experimental Solid Mechanics (2009), a chapter on Digital Photoelasticity in the book on Digital Optical Measurement Techniques and Applications (2015), Artech House London and a recently published book on Developments in Photoelasticity - A renaissance (2021), IOP Publishing, UK. He has over 190 publications to date of which two have been reproduced in the Milestone Series of SPIE. His research has been funded by organizations such as ARDB, ISRO, DST, EU (FP7) and NSF. He received the Zandman award for the year 2012, the first Indian to receive it since its inception in 1989, instituted by the Society for Experimental Mechanics, USA for his outstanding research contributions in applications utilizing photoelastic coatings. He has been a Fellow of the Indian National Academy of Engineering since 2006. He received several awards such as Distinguished Alumnus Award of NIT, Trichy (2008), President of India Cash Prize (1984). He has been a member of the Editorial Boards of the International Journals: Strain (since 2001), Journal of Strain Analysis for Engineering Design (2009–10), Optics and Lasers in Engineering, and a steering committee member of Asian Society for Experimental Mechanics since its inception in 2000. For Details See: <https://home.iitm.ac.in/kramesh>

COURSE PLAN :

Week 1: Overview of Experimental Stress Analysis

Week 2: Physical Principle of Experimental Techniques, Introduction to Various experimental Techniques

Week 3: Fringe Patterns - Richness of Qualitative Information, Multi Scale Analysis

Week 4: Selection of Experimental Techniques, Introduction to Crystal Optics

Week 5: Light Ellipse, Retardation Plates and Plane Polariscope

Week 6: Jones Calculus, Plane and Circular Polariscope analysis

Week 7: Compensation Techniques, Calibration of Photoelastic Materials

Week 8: Fringe ordering and Three-Dimensional Photoelasticity

Week 9: Photoelastic Coatings

Week 10: Brittle Coatings and Strain Gauges Introduction

Week 11: Strain Gauge Alloys, Performance of Strain Gauge System

Week 12: Correction factor for Special Applications



FOUNDATIONS OF COMPUTATIONAL MATERIALS MODELLING

PROF. NARASIMHAN SWAMINATHAN

Department of Mechanical Engineering

IIT Madras

TYPE OF COURSE : Rerun | Elective | PG

COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)

EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Basic Materials Science Course at the undergraduate level, MATLAB programming, familiarity with LINUX is preferred.

INTENDED AUDIENCE : All Engineering students

INDUSTRIES APPLICABLE TO :None. This course will be useful for students pursuing research requiring molecular simulations of solids.

COURSE OUTLINE :

This course provides the necessary foundations to (a) build computational samples of crystals (b) Introduce statistical mechanics and its connection to Molecular dynamics (c) Provide enough ground in Molecular dynamics using LAMMPS

ABOUT INSTRUCTOR :

The instructor Dr. Narasimhan Swaminathan is an Associate Professor in the Dept. of Mechanical Engineering at IIT Madras. Prior to this, he was a Post Doctoral Research Associate in the Materials Science and Engineering Department at University of Wisconsin, USA. Dr. Narasimhan obtained his Ph.d. from the Georgia Institute of Technology in 2009. His current research areas include molecular simulations to study radiation damage, polymer mechanics, etc. He also studies stress-diffusion interaction in Li-ion battery electrodes using continuum mechanics.

COURSE PLAN :

Week 1: Introduction to Computational Modeling

Week 2: Introduction to Crystals

Week 3: Symmetry in Crystals

Week 4: Plane Groups

Week 5: Space Groups

Week 6: Construction of 2D and 3D crystals in MATLAB

Week 7: Statistical Mechanics

Week 8: Statistical Mechanics, cont'd

Week 9: Introduction to Molecular Dynamics

Week 10: Molecular dynamics using LAMMPS – 1

Week 11: Molecular dynamics using LAMMPS -2

Week 12: Molecular dynamics using LAMMPS -3 and Closure



FUNDAMENTALS OF SEMICONDUCTOR DEVICES

PROF. DIGBIJOY N. NATH

Centre for Nano Science and Engineering (CeNSE)
IISc Bangalore

PRE-REQUISITES : High school physics & math, 10+2 physics

INTENDED AUDIENCE : Students pursuing B.E./B.Tech in ECE/EE, or M. Sc Physics

INDUSTRIES APPLICABLE TO : Semiconductor

COURSE OUTLINE :

This course seeks to cover the basics of semiconductor devices including the physics of energy bands, doping and carrier statistics and transport leading up to the understanding of common semiconductor devices including p-n junctions and their applications, BJTs and MOSFETs. The course will also give a flavour of the basics of compound semiconductors and their devices, and also touch base with opto-electronic devices such as solar cells, photodetectors and LEDs. The course will ensure that undergraduates, college teachers and other interested audience with no background in semiconductors are able to grasp the content. In parallel, the course will consistently seek to engage the audience by giving real-life examples pertaining to the content, and also seek to calibrate the content with respect to practical and commercial technologies which are all around us and which use semiconductor devices. There will be enough food for thought even for advanced learners such as PhD students and active researchers.

ABOUT INSTRUCTOR :

Prof. Digbijoy N. Nath completed his B.E. (Hons) in Electrical and Electronics Engineering from BITS, Pilani (Rajasthan) and PhD in Electrical Engineering from Ohio State University, Columbus specializing in gallium nitride based semiconductor devices. He has been as Assistant Professor at Centre for Nano Science and Engineering (CeNSE) at Indian Institute of Science (IISc), Bangalore since Aug 2014. His research interests lie in wide band gap semiconductor devices for high power & RF electronics/deep-UV opto-electronics. He has authored/co-authored 46 publications so far. He has been teaching a postgraduate level course Semiconductor Devices and IC Technology for PhD/Masters students at IISc for four years while he has also started a new advanced-level course titled Semiconductor Opto-electronics and Photovoltaics (jointly with another faculty member).

COURSE PLAN :

Week 1 : Importance of semiconductor devices and their diverse applications. Introduction to semiconductors, concept of energy bands and how bands form. Effective mass of electrons, E-k diagram. Concept of holes. Concept of Fermi level, Fermi-Dirac distribution. Doping (extrinsic & intrinsic semiconductor), density of states.

Week 2 : Equilibrium electron-hole concentration, temperature-dependence. Carrier scattering and mobility, velocity saturation, Drift-diffusion transport

Week 3 : Excess carrier decay & recombination, charge injection, continuity equation, quasi-Fermi level

Week 4 : p-n junction: static behaviour (depletion width, field profile), p-n junction under forward & reverse bias, current equations, generation-recombination current and reference to typical devices.

Week 5 : Zener and avalanche breakdown, Capacitance-voltage profiling, metal/semiconductor junction – Ohmic and Schottky contacts, reference to device applications.

Week 6 : MOS capacitor, charge/field/energy bands, accumulation, inversion, C-V (high and low frequencies), deep depletion, Real MOS cap: Flat-band & threshold voltage, Si/SiO₂ system.

Week 7 : MOSFET: structure and operating principle, derivation of I-V, gradual channel approximation, substrate bias effects, sub-threshold current and gate oxide breakdown. Control of threshold voltage, short channel effects. Moore's Law and CMOS scaling

Week 8 : Introduction to compound semiconductors & alloys, commonly used compound semiconductors, heterostructure band diagrams and basics of MODFET & HEMT, introduction to quantum well, applications of heterostructure device technologies

Week 9 : BJT: working principle, DC parameters and current components, base transport factor, Early Effect, charge control equation & current gain, need for HBT. Applications of BJTs/HBTs in real-life.

Week 10 : (Basics of) - transistors for high-speed logic, transistors for high frequency (RF), transistors for high power switching, transistors for memories, transistors for low noise, transistors for the future.

Week 11 : Solar cells: principle, efficiency, Fill factor, Shockley-Queisser limit, silicon solar cells, multi-junction solar cell, Photodetectors: operation, figures of merit (responsivity, QE, bandwidth, noise, Detectivity), examples from IR to UV detectors.

Week 12 : LEDs: working principle, radiative/non-radiative recombination, various types of efficiencies (EQE, WPE, IQE), light extraction and escape cone. Blue LED and the Nobel Prize, visible LEDs and chromaticity.



FUNDAMENTALS OF SURFACE ENGINEERING: MECHANISMS, PROCESSES AND CHARACTERIZATIONS

PROF. D.K. DWIVEDI

Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Elective | PG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 24 Apr 2022

INTENDED AUDIENCE : UG and PG Student, Research Scholar & Practicing Engineers

INDUSTRIES APPLICABLE TO : Mining, Hydropower, Cement and Manufacturing

COURSE OUTLINE :

The course content is designed to have systematic and comprehensive understanding on various aspects related with surface engineering of metallic components for enhanced tribological life. It is proposed to include fundamental mechanisms of wear such as adhesive, abrasive, erosive, cavitation, corrosion etc., governing laws, materials properties importance for improved wear resistance under different wear conditions, materials increased tribological life, processes for engineering surfaces of three broad categories a) regulating the micro-structure without changing chemical composition b) modification of chemical composition of near surface layers and c) developing of films, coating, and cladding on the. Methods of characterization needed for evaluating the metallurgical and mechanical and tribological properties and performance of engineered surfaces shall also be presented. Presentations will be supported with case studies for effective communication of concepts and procedures. Case studies will be taken up regarding surface engineering of various metal systems like ferrous and non-ferrous metals using different approaches discussed.

ABOUT INSTRUCTOR :

Prof. D.K. Dwivedi obtained BE (Mechanical Engineering) , in 1993 from GEC Rewa, ME (welding engineering) from Univ. of Roorkee in 1997 and PhD in Met. Engineering from MNIT, Jaipur in 2003. He has about 9 years teaching experience at NIT Hamirpur and 12 years at IIT Roorkee of subjects related with manufacturing at UG level and welding engineering related subjects at PG level including failure analysis of welded joints. He has undertaken work of failure investigation valves, penstocks, bridges for many private and public sector industries especially in hydropower sector.

COURSE PLAN :

Week 01 : Introduction

Week 02 : Introduction - contd.

Week 03 : Surface damage

Week 04 : Surface damage - contd.

Week 05 : Materials for wear resistant applications

Week 06 : Processes for Controlling Wear: Structural Modification

Week 07 : Processes for Controlling Wear: Composition Modification

Week 08 : Processes for Controlling Wear: Composition Modification - contd.

Week 09 : Processes for Controlling Wear: Composition Modification & Weld Surfacing

Week 10 : Processes for Controlling Wear: Coatings & Cladding

Week 11 : Processes for Controlling Wear: Coatings & Overlays

Week 12 : Processes for Controlling Wear: Coatings & Characterization



GEOGRAPHIC INFORMATION SYSTEMS

PROF. ARUN K. SARAF

Department of Civil Engineering
IIT Roorkee

PRE-REQUISITES : Current students of engineering, post graduate science students and PhD students should have basic knowledge of computers

INTENDED AUDIENCE : Under and post-graduate engineering, post graduate and doctoral students

INDUSTRIES APPLICABLE TO : Geoinformatics companies, e.g NIIT, ESRI India, Leica Geoinformatics, MapmyIndia, ISRO, etc.

COURSE OUTLINE :

The proposed course provides detailed understanding about Geographic Information Systems and their applications in Civil Engineering and Earth Sciences. All aspects starting from data input to modelling would be discussed in this course. Further, in the proposed course various datasets including DEMs, their source, generation techniques, derivatives, errors and limitations would be discussed extensively. Surface Hydrologic Modelling using DEMs, modelling derivatives and their applications would also be discussed.

ABOUT INSTRUCTOR :

Prof. Arun K. Saraf is Ph. D. (Remote Sensing) from University of Dundee, United Kingdom. Presently he is working as Professor in the Department of Earth Sciences, Indian Institute of Technology, Roorkee, and teaches courses on Geographic Information Systems (GIS), Advanced GIS, Remote Sensing, Geomorphology etc. to under- and post-graduate students of Geological Technology and Applied Geology. He was also Head of Department of Earth Sciences between Jan. 2012-Feb. 2015. He was first in the country to introduce GIS course to post-graduate students in the year 1990. In 1986, he was awarded National Fellowship to Study Abroad by Govt. of India for his doctoral degree.

COURSE PLAN :

Week 1: What is Geographic Information Systems?, Essential components of GIS, Different types of vector data, Concept of topology, Demonstration through GIS software

Week 2: Raster data model and comparisons with vector, TIN data model and comparisons with raster, Non-spatial data (attributes) and their types, Vector Data Compression Techniques, Demonstration through GIS software

Week 3: Raster Data Compression Techniques-01, Raster Data Compression Techniques-02, Georeferencing, Pre- processing of spatial datasets-01, Demonstration through GIS software

Week 4: Pre-processing of spatial datasets-02, Pre-processing of spatial datasets-03, Spatial Interpolation Techniques-01, Spatial Interpolation Techniques-02, GIS Analysis- 01

Week 5: GIS Analysis-02, GIS Analysis-03, GIS Analysis- 04, GIS Analysis-05, Demonstration through GIS software

Week 6: GIS Analysis-06, GIS Analysis-07, Attributes Classification Methods, Spatial Database systems and their types-01, Demonstration through GIS software

Week 7: Spatial Database systems and their types-02, Concept of NoData in Raster, Different map projections, Concept of digital elevation model (DEM) and how it is represented, Demonstration through GIS software

Week 8: Various techniques to generate digital elevation models-1, Various techniques to generate digital elevation models-2, Various techniques to generate digital elevation models-3, Digital Elevation Models and different types of resolutions, Demonstration through GIS software

Week 9: How to assess quality of a DEM, Integration of DEMs with satellite data, Common derivatives of DEMs - Slope and aspect-01, Common derivatives of DEMs - Slope and aspect-02, Demonstration through GIS software

Week 10: Common derivatives of DEMs - Slope and aspect-03, DEMs derivatives-1, DEMs derivatives-2, DEMs derivatives-3, DEMs derivatives-4

Week 11: Triangulated Irregular Network (TIN) and its derivatives, Shaded relief models and their applications, DEM based Surface Hydrologic Modelling-1, DEM based Surface Hydrologic Modelling-2, DEMs and Dam Simulation and its application in groundwater hydrology

Week 12: DEMs Sources, limitations and future of Digital Elevation Models, Applications of DEMs in Viewshed and Flood Hazard Mapping, Applications of DEMs in solar and wind energy potential estimations, Errors in GIS and key elements of maps, Limitations and Rules of GIS



GERMAN - I

PROF. MILIND BRAHME

Department of Humanities and Social Sciences
IIT Madras

INTENDED AUDIENCE : Anyone interested in learning elementary German

INDUSTRIES APPLICABLE TO : Companies / Organisations / Individuals having business / work with Germany, Austria and/or Switzerland

COURSE OUTLINE :

German I is meant to be an introduction to the German language and a basic orientation towards Germany (and to some extent Austria and Switzerland). Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of Germany as a cultural space are the overall objectives of the course. Serious learners should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

ABOUT INSTRUCTOR :

Prof. Milind Brahme has an MA, M Phil and a PhD in German language and literature from the Centre of German Studies, JNU. He has been on the faculty of IIT Madras since 2003, and has more than 25 years of experience of teaching German language and literature in diverse situations and contexts.

COURSE PLAN :

Week 1: Themes: Introducing oneself and others; Grammar: W questions, personal pronouns, simple sentence, verb conjugation

Week 2: Themes: hobbies, the week, numbers, the alphabet, months, seasons / Grammar : articles , plural, the verbs to have and to be

Week 3: Theme: In the city / naming places and buildings, means of transport, basic directions / Grammar : definite and indefinite articles; negation - kein and nicht; imperative

Week 4: Themes: food, drink, family / groceries and meals / Grammar : the accusative

Week 5: Theme: Everyday life, telling time, making appointments / Grammar : prepositions am, um, von..bis; modal verbs, possessive articles

Week 6: Leisure activity, celebrations / Grammar: separable verbs, the accusative, past tense of to have and to be

Week 7: Contacts, writing letters / Grammar: dative

Week 8: My apartment, rooms, furniture, colours / Grammar: changing prepositions

Week 9: Professions / Grammar : perfect tense

Week 10: Clothes / Grammar: perfect tense and dative

Week 11: Health and the body / Grammar: the imperative and modal verbs

Week 12: Holiday and weather



GOOGLE CLOUD COMPUTING FOUNDATIONS

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Guwahati

COURSE OUTLINE :

The Google Cloud Computing Foundations course aims to provide a detailed overview of concepts covering cloud basics, big data, and machine learning and where and how the Google Cloud Platform fits in. The course involves understanding concepts and perform hands-on training (via Qwiklabs platform) to practice the learning. There are 26 labs on Qwiklabs that are part of the course.

Those enrolling for the course should ideally:

- Have basic IT knowledge and be interested in learning more about Cloud and ML.
- Have competency in at least one language (such as Python, Java).
- Be familiar with the basics of shell scripting, SQL.

Disclaimer:

Google may contact you by email to provision benefits and send surveys and other communication related to the Google Cloud Computing Foundations Course.

By joining, you agree to Google Cloud Training tracking your grades and other activity in it's learning program.

ABOUT INSTRUCTOR :

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN :

Week 0: Introduction to the course

Week 1: So, What's the Cloud anyway? Start with a Solid Platform

Week 2: Use GCP to build your Apps

Week 3: Where do I store this stuff?

Week 4: There's an API for that! You can't secure the Cloud right?

Week 5: It helps to network!

Week 6: It helps to network (continued)

Week 7: Let Google keep an eye on things. You have the data, but what are you doing with it?

Week 8: Let machines do the work



GPS SURVEYING

PROF. JAYANTA KUMAR GHOSH

Department of Civil Engineering

IIT Roorkee

- INTENDED AUDIENCE** : Diploma/Degree/Master/Doctoral students; Field surveyors; Professional persons dealing with GPS surveying.
- Application based.As core course (partial) for Civil Engineering,Geo-spatial Technology etc.
- As elective course (partial) for Earth Sciences,Geography etc for all domains in which GPS surveying may be applied.
- May be considered for both course (UG & PG).
- Part of any of the degrees: (BE/ME/BSc/MSc etc).
- PRE-REQUISITES** : Basics of Physics and mathematics upto 12th standard and familiarity with use of computer.

COURSE OUTLINE :

The objective of the course is to provide optimal insights into land surveying using GPS (Global Positioning System). The course starts with an introduction to land surveying leading to GPS as the state-of-art for surveying of land. Then, different aspects of GPS systems such as GPS architecture, GPS signals, GPS receivers, GPS software has been discussed followed by GPS positioning & GPS observables. Next, it provides GPS processing fundamentals consisting of pre-processing and processing steps under different processing strategies followed by quality assessment and field procedure of GPS surveying. The course concludes with a detail demonstration of GPS field surveying followed by processing of collected data.

ABOUT INSTRUCTOR :

Prof. Jayanta Kumar Ghosh is working as Associate Professor in the Civil Engineering Department (Geomatics Engineering Group) of Indian Institute of Technology Roorkee. He is engaged in teaching, research and consultancy works in Geomatics engineering for more than 30 years. He is pioneer in introducing courses on GPS surveying in the UG & PG curriculum of Civil Engineering in India, since 1999. He has conducted many short term courses on GPS Surveying for the building professionals as early as 2002. He has more than 85 publications in the International and National journals and conferences of repute. He is member of different National and International technical associations.

COURSE PLAN :

Week 1: Introduction; GPS System

Week 2: GPS Positioning; GPS Observables

Week 3: GPS Data Processing

Week 4: GPS Field Surveying; GPS Field Data Processing

Graph Theory - Web course

COURSE OUTLINE

- **Preliminaries:** Graphs, isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences
- **Connected graphs and shortest paths:** Walks, trails, paths, connected graphs, distance, cut-vertices, cut-edges, blocks, connectivity, weighted graphs, shortest path algorithms
- **Trees:** Characterizations, number of trees, minimum spanning trees
- **Special classes of graphs:** Bipartite graphs, line graphs, chordal graphs
- **Eulerian graphs:** Characterization, Fleury's algorithm, chinese-postman-problem
- **Hamilton graphs:** Necessary conditions and sufficient conditions
- **Independent sets, coverings, matchings:** Basic equations, matchings in bipartite graphs, perfect matchings, greedy and approximation algorithms
- **Vertex colorings:** Chromatic number and cliques, greedy coloring algorithm, coloring of chordal graphs, Brook's theorem
- **Edge colorings:** Gupta-Vizing theorem, Class-1 graphs and class-2 graphs, equitable edge-coloring
- **Planar graphs:** Basic concepts, Eulers formula, polyhedrons and planar graphs, characterizations, planarity testing, 5-color-theorem
- **Directed graphs:** Out-degree, in-degree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments

COURSE DETAIL

Modules	Contents (optional topics are indicated in bold)	Number of lectures	Number of lectures



NP-TEL

NPTEL

<http://nptel.iitm.ac.in>

Mathematics

Additional Reading:

1. F. Harary: Graph Theory, Narosa, (1988)
2. C. Berge: Graphs and Hypergraphs, North Holland/Elsevier, (1973)

Coordinators:

Prof. S.A. Choudum
Department of
Mathematics IIT Madras

			by skipping optional topics	
1. Preliminaries	Graphs, isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences	5-10	4	
2. Connected graphs and shortest paths	Walks, trails, paths, connected graphs, distance, cut-vertices, cut-edges, blocks, weighted graphs, connectivity, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm	4-8	4	
3. Trees	Characterizations, number of trees , minimum spanning trees	5-10	4	
4. Special classes of graphs	Bipartite graphs, line graphs, chordal graphs	6-12	2	
5. Eulerian graphs	Characterization, Fleury's algorithm, chinese-postman-problem	2-4	2	
6. Hamilton graphs	Necessary conditions and sufficient conditions	4-8	4	
7. Independent sets,	Basic equations, matchings in bipartite graphs, perfect	8-16	6	

coverings and matchings	matchings, greedy and approximation algorithms		
8. Vertex-colorings	Chromatic number and cliques, greedy coloring algorithm, coloring of chordal graphs, Brook's theorem	4-8	2
9. Edge-colorings	Gupta-Vizing theorem, Class-1 graphs and class-2 graphs, equitable edge-coloring	8-16	6
10. Planar graphs	Basic concepts, Eulers formula, polyhedrons and planar graphs, characterizations, planarity testing, 5-color-theorem	10-20	3
11. Directed graphs	Directed graph, underlying graph, out-degree, in-degree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments	8-16	6

References:

Text Books:

1. J.A. Bondy and U.S.R.Murty: Graph Theory and Applications (Freely downloadable from Bondy's website; Google-Bondy)
2. D.B.West: Introduction to Graph Theory, Prentice-Hall of India/Pearson, 2009 (latest impression)

Reference Books:

1. J.A.Bondy and U.S.R.Murty: Graph Theory, Springer, 2008.

2. R.Diestel: Graph Theory, Springer(low price edition) 2000.

A joint venture by IISc and IITs, funded by MHRD, Govt of India

<http://nptel.iitm.ac.in>



HUMAN BEHAVIOUR

PROF. NAVEEN KASHYAP

Department of Humanities and Social Sciences
IIT Guwahati

INTENDED AUDIENCE : UG/PG/PhD students

COURSE OUTLINE:

We as intelligent beings have always wondered why we do what we do. The most interesting knowledge that humans beings would kill to possess would be the knowledge to control other people. The basic premise of being human is individual difference (we are all different). One science that helps people in understanding other people and scientifically predicting their actions is the science of psychology. In the present course, I will make an attempt to simplify the science of human behavior.

ABOUT INSTRUCTOR :

Prof. Naveen Kashyap, Ph.D is as Associate Professor of Psychology at the Indian Institute of Technology Guwahati. His research interests are sleep and human cognitive processes. Dr Kashyap has been teaching courses like cognitive psychology, introduction to psychology, consumer psychology, advance cognitive process and research methodology to UG and PG students of IITG Guwahati for the past 10 years.

COURSE PLAN :

Week 1 : Introduction to the science of human behavior

Week 2 : Sensation & Perception-I

Week 3 : Perception-II, Learning

Week 4 : Memory and Language-I

Week 5 : Language-II and Emotion

Week 6 : Intelligence

Week 7 : Personality

Week 8 : Social influence and cognition



INTRODUCTION TO AEROSPACE ENGINEERING-FLIGHT

PROF. RAJKUMAR S. PANT

Department of Aerospace Engineering
IIT Bombay

INTENDED AUDIENCE : Any discipline of Engineering, who are interested in the subject

INDUSTRY SUPPORT : DRDO, HAL, NAL, IAF

COURSE OUTLINE :

The aim of this course is to provide a general overview of the field of Aeronautical Engineering to interested students. The course will consist of ten Capsules, each consisting of two Lectures. Each Lecture will cover a specific concept or area relevant to the subject. An attempt will be made to cover the contents in an interesting manner, by a judicious use of a mix of powerpoint presentations, in-class activities, quizzes, innovative and hands on assignments that will not only increase the awareness of the students, but also satiate their curiosity and desire to know more about the various concepts related to the subject.

ABOUT INSTRUCTOR :

Prof. Rajkumar S. Pant has Bachelors, Masters and Ph.D. degrees in Aerospace Engineering. His areas of specialization include Aircraft Conceptual Design, Air Transportation, and Optimization. He has been a member of faculty of Aerospace Engineering Department at the Indian Institute of Technology Bombay since December 1989. Prof. Pant is an alumnus of College of Aeronautics, Cranfield University, UK, where he earned his Ph.D. under Commonwealth Scholarship Scheme, IIT Madras, where he did his Masters in Aeronautical Engineering, and PEC Chandigarh where he underwent his undergraduate studies in Aeronautical Engineering. He has also worked for five years in Hindustan Aeronautics Limited in the Design & Engineering Department at Kanpur (3.5 years) and Nasik (1.5 years) Divisions. He has published and presented ~ 220 scientific papers, of which ~ 170 are in international journals and conferences. He has also visited several top ranking institutes and universities all over the world. Prof. Pant was a Visiting Professor at School of Mechanical & Aerospace Engineering at Nanyang Technological University, Singapore in 2015-16, visiting faculty at Department of Aerospace & Ocean Engineering at Virginia Polytechnic Institute and State University in 2010-11, and a visiting researcher at Instituto Tecnológico de Aeronáutica, Brazil in 2012, Texas A&M University in 2011, Cambridge University in 2008, and Imperial College London in 2006. In November 2012, he was appointed as a Special Visiting Researcher under the Science Without Borders program of the Brazilian Government for three years

COURSE PLAN :

Week 1: Atmosphere and its properties

Week 2: Nomenclature of aircraft components

Week 3: Fluid Mechanics – I : Incompressible flow, Bernoulli's Equation, Coanda Effect, and Mach No..

Week 4: Fluid Mechanics –II : Viscous Flow, Boundary Layer, Pressure Measurement

Week 5: Aerodynamics – I : Airfoils, and Lift Generation Theories

Week 6: Aerodynamics – II : Critical Mach no., Types of Drag

Week 7: Propulsion : Types of Aircraft Engines

Week 8: Aircraft Performance - I : Steady Level Flight and Altitude effects

Week 9: Aircraft Performance- II : Glide, Climb, Ceilings, Turn, and Pull up

Week 10: Aircraft Longitudinal Stability, and V-n Diagram

Week 11: Aircraft Performance- III : Takeoff and Landing, Range and Endurance, Range-Payload Diagram

Week 12: Flapping Wing Aerodynamics



INTRODUCTION TO BRAIN & BEHAVIOUR

PROF. ARK VERMA

Department of Humanities and Social Sciences
IIT Kanpur

TYPE OF COURSE : Rerun | Core | PG

COURSE DURATION : 8 weeks (21 Feb' 22 - 15 Apr' 22)

EXAM DATE : April 24, 2022

INTENDED AUDIENCE : Students across various disciplines from the Cognitive Sciences, Neurosciences, Psychology doing either their Bachelors or Masters, and even PhD may benefit from this course.

COURSE OUTLINE :

The course is meant to familiarise the students with the neural basis of mental/cognitive processes. The course will stress on both how the mental functions operate to give rise to human behaviour and also simultaneously show how these processes are implemented in the human brain.

ABOUT INSTRUCTOR :

Prof. Ark Verma have done my Bachelor's Degree in Psychology & English Literature from the University of Allahabad in 2007. After that I did my Master's Degree in Cognitive Science at the Centre of Behavioral & Cognitive Sciences, University of Allahabad in 2009. I joined the PhD program in the Department of Experimental Psychology at Ghent University, Belgium in January 2010 & was awarded my PhD in 2014. I joined IIT Kanpur as an Assistant Professor of Psychology in May 2015. My research lies in the field of Cognitive Psychology (Lateralisation, Symmetry Detection, Attention) & Psycholinguistics (Visual Word Recognition & Bilingualism).

COURSE PLAN :

Week 1 : A Brief History of Cognitive Neuroscience. Structure and Function of the Nervous System.

Week 2 : Methods in Cognitive Neuroscience

Week 3 : Neural Basis of Sensation and Perception.

Week 4 : Neural Basis of Object Recognition.

Week 5 : Neural Basis of Attention and Consciousness.

Week 6 : Neural Basis of Learning and Memory.

Week 7 : Neural Basis of Language & Cognitive Control.

Week 8 : Special Topics in Cognitive Neuroscience.



INTRODUCTION TO EMBEDDED SYSTEM DESIGN

PROF. DHANANJAY V. GADRE

Department of Electrical, Electronics and Communications Engineering
Netaji Subhas University of Technology,

PROF. BADRI SUBUDHI

Department of Electrical, Electronics and Communications Engineering
IIT Jammu

PRE-REQUISITES : Anyone with understanding of basic electronic components and circuits, digital electronics and C programming.

INTENDED AUDIENCE : Undergraduate students in engineering and science.

INDUSTRIES APPLICABLE TO : Supported by Texas Instruments.

COURSE OUTLINE :

Embedded Systems surround us in the form of gadgets and devices that we use. There is no aspect of human lives, which is untouched by such devices at home or for health diagnostics, transportation, entertainment. Learning about Embedded Systems will give the skills to design and manufacture embedded system products of the future which will help participants towards better employability. This course teaches embedded system design using a building block approach, which allows one to visualize the requirement of an embedded system and then to design it efficiently. The course will teach embedded system design using a microcontroller, namely Texas Instruments MSP430 low power microcontroller. The course will introduce various interfacing techniques for popular input devices including sensors, output devices and communication protocols. It will teach power supply design for embedded applications. It will also teach effective embedded programming techniques in C and how to maintain code using GIT. It will have a significant practical component, which will be achieved through any available MSP430 microcontroller kit

ABOUT INSTRUCTOR :

Dhananjay V. Gadre (New Delhi, India) completed his Ph.D. in Instrumentation and Control Engineering from University of Delhi. He has a M.Engr. (Computer Engineering) from the University of Idaho, USA after his M.Sc. (Electronic Science) from the University of Delhi, South Campus and B.Sc. (General with Electronics) from the Atma Ram Sanatan Dharma College, University of Delhi.

Prof. Gadre teaches at the Netaji Subhas University of Technology (formerly Netaji Subhas Institute of Technology) in the Department of Electronics and Communication Engineering, currently as an Associate Professor. He is also the founder director of CEDT and TI-CEPD.

At NSUT, he established two open access laboratories, namely Centre for Electronics Design and Technology (CEDT) and Texas Instruments Centre for Embedded Product Design (TI-CEPD). CEDT started functioning at NSUT (NSIT at the time) under his guidance in 2003 and has trained more than 5000 students in various activities related to hands-on electronics and system design. TI-CEPD started as a result of an MOU between Texas Instruments India and NSIT in 2012, under his direction. At TI-CEPD, he organized month-long, hands-on "Internship Workshops on Embedded System Design" for undergraduate and postgraduate engineering and science students, PhD scholars and young faculty and 12 such workshops were organized between June 2013 and July 2017 benefiting around 1000 participants. Activities in these two labs have resulted in many projects, products, and publications including books as well as mentoring of a few startups and providing help and guidance to science related NGOs.

Since 2001, he has been a member of an expert committee constituted by Centre for Development of Advanced Computing (CDAC), Pune for their flagship post graduate diploma program in Embedded System Design (DESD). This program has been running continuously for more than 20 years and has graduated more than 15,000 professionals in this field. Since January 2018, he has been an editor of IETE Journal of Education. Also in 2018, he received an invitation to be an adjunct faculty at IIT Jammu.

Prof. Gadre is keenly interested in creating content and pedagogy material for online learning. In September 2020, his first Massive Open Online Course (MOOC) on 'Introduction to Embedded System Design' was launched on the NPTEL platform of the Swayam portal of Government of India. This course is suitable for undergraduate and postgraduate students in science and engineering, and has been supported by Texas Instruments. This course was offered again in the January 2021 session, January 2023 session and January 2024 session at the NPTEL platform. More than seventy thousand students registered for these three editions of his MOOC. Incidentally, this is the only MOOC by any faculty member of DU/IGDTUW/NSUT/JMI/IPU.

Since 2016 he has been mentoring schools to acquire an 'Atal Tinkering Laboratory' under a Niti Aayog scheme of the Government of India and to help the selected schools run these laboratories efficiently. In December 2020, AICTE launched the IDEA Lab scheme. Prof. Gadre was co-opted as a founding member of the National Steering Committee to oversee the effective operation and implementation of the IDEA Lab scheme.

In his professional career of 34 years, he taught at the SGTB Khalsa College, University of Delhi followed by a stint as a scientific officer at the Inter University Centre for Astronomy and Astrophysics (IUCAA), Pune, designing instrumentation for use in astronomy. He has lectured and demonstrated his work extensively across the length and breadth of India and five continents, including at the World Economic Forum at Davos in Switzerland on topics related to electronics and embedded systems.

Prof. Gadre is the author of several professional articles and six books. One of his books has been translated into Chinese and another one into Greek. His recent book "TinyAVR Microcontroller Projects for the Evil Genius", published by McGraw Hill International (New York) consists of more than 30 hands-on projects and has been translated into Chinese and Russian. His latest book on TIVA ARM Cortex M4 microcontrollers is published by Springer Nature.

His professional interests include scientific instrumentation, digital systems design and computer architecture, embedded systems and Internet of Things. He is a licensed radio amateur with a call sign VU2NOX since 1986 and hopes to design, build and launch an amateur radio satellite in the near future.

Prof. Badri N Subudhi received M.Tech. in Electronics and System Communication from National Institute of Technology, Rourkela, India, in 2008-09. He worked for his PhD from Machine Intelligence Unit, Indian Statistical Institute, Kolkata, India in year 2014 (degree from Jadavpur University). Currently he is serving as an Assistant Professor at Indian Institute of Technology Jammu, India. Prior to this he was working as an Assistant Professor at NIT Goa from July 2014 to March 2017. He received CSIR senior research fellowship for the year 2011-2015. He was nominated as the Young Scientist Awardees by Indian Science Congress Association for the year 2012-2013. He was awarded with Young Scientist Travel grant award from DST, Government of India and Council of Scientific and Industrial Research, India in the year 2011. He is the receiptant of Bose-Ramagnosi Award for the year 2010 from DST, Government of India under India-Trento Programme for Advanced Research (ITPAR). He was a visiting scientist at University of Trento, Italy during Aug. 2010 to Feb 2011. His research interests include Video Processing, Image Processing, Medical Image Processing, Machine Learning, Pattern Recognition, and Remote Sensing Image Analysis.

COURSE PLAN:

Week 1: Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply.

Week 2: Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance.

Week 3: Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems.

Week 4: Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform.

Week 5: Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD). Assignment: MCQ/MSQ

Week 6: Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder.

Week 7: Programming the MSP430. Basics of version control system - Git. Installing and using Code Composer Studio (CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.

Week 8: MSP430 Clock and Reset System. MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR).

Week 9: Interfacing Seven Segment Displays and Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. Introduction to MSP430 Timer Module and its Modes of Operation.

Week 10: Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Adding DAC to MSP430. Custom Waveform generation using MSP430.

Week 11: Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface (USCI) Module of the MSP430 for UART Communication. Advanced Coding Exercises based on Interrupt driven Programming. Building an Electronics Project.

Week 12: Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage.



INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic knowledge of computer and internet

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engg, Industrial Engineering, Industry Professionals

INDUSTRIES APPLICABLE TO : All Industrial Sectors

COURSE OUTLINE :

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle. This course has been organized into the following modules:.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN:

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab



INTRODUCTION TO INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic programming knowledge

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engineering, Industrial Engineering

COURSE OUTLINE :

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN :

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud Computing(contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring



INTRODUCTION TO PROGRAMMING IN C

PROF. SATYADEV NANDAKUMAR

Dept. of Computer Science and Engineering
IIT Kanpur

INTENDED AUDIENCE : Any interested learners.

PRE-REQUISITES : No prior programming required; mathematical maturity of a second level UG student in science or engineering.

COURSE OUTLINE :

This is a course in programming in C. No prior programming experience is assumed; however, mathematical maturity at the level of a second year science or engineering undergraduate is assumed. We emphasize solving problems using the language, and introduce standard programming techniques like alternation, iteration and recursion. We will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams.

ABOUT INSTRUCTOR :

Prof. Satyadev Nandakumar is an Assistant Professor from the Department of Computer Science and Engineering IIT Kanpur who specialises in Computable Analysis, Algorithmic Information Theory, Symbolic Dynamics. His research interests includes Theoretical Computer Science, Algorithmic Information Theory, Computable Analysis.

COURSE PLAN :

Week 01 : Introduction. Straight-Line Code. Variables, Operators, Expressions and Conditionals.

Week 02 : Loops.

Week 03 : Functions.

Week 04 : One-Dimensional Arrays and Pointers.

Week 05 : Recursion.

Week 06 : Multi-dimensional Arrays, Linked Lists.

Week 07 : Operating on Files.

Week 08 : Organizing C projects, working with multiple source directories, makefiles.



INTRODUCTION TO PSYCHOLOGY

PROF. BRAJ BHUSHAN

Department of Humanities and Social Sciences

IIT Kanpur

INTENDED AUDIENCE : Elective UG, BE, BSc

INDUSTRIES APPLICABLE TO : HR section the companies

COURSE OUTLINE :

This course is designed for better understanding of the self and others. It will help you understand the how and why of thinking, feeling, and action. This introductory psychology course will cover the major psychological constructs and principles, primarily focusing on the perceptual processes, learning, memory, emotions, genetic and environmental determinants of behavior and personality. In the last week it will also demonstrate some lab sessions whereby the relevant construct and phenomena can be empirically tested.

ABOUT INSTRUCTOR :

Prof. Braj Bhushan is a professor of psychology at IIT Kanpur.

COURSE PLAN :

Week 1: Why Psychology? Major milestones in psychology, Major areas of psychology, Major methods used in psychology, Redefining boundaries of the discipline

Week 2: Perception

Week 3: Learning

Week 4: Memory

Week 5: Emotion

Week 6: Genetic and Environmental bases of behaviour

Week 7: Personality

Week 8: Lab session: Perception



INTRODUCTION TO MACHINE LEARNING

PROF. BALARAMAN RAVINDRAN

Department of Computer Science and Engineering
IIT Madras

INTENDED AUDIENCE: This is an elective course. Intended for senior UG/PG students. BE/ME/MS/PhD

PRE-REQUISITES: We will assume that the students know programming for some of the assignments. If the students have done introductory courses on probability theory and linear algebra it would be helpful. We will review some of the basic topics in the first two weeks as well.

INDUSTRY SUPPORT: Any company in the data analytics/data science/big data domain would value this course.

COURSE OUTLINE :

With the increased availability of data from varied sources there has been increasing attention paid to the various data driven disciplines such as analytics and machine learning. In this course we intend to introduce some of the basic concepts of machine learning from a mathematically well motivated perspective. We will cover the different learning paradigms and some of the more popular algorithms and architectures used in each of these paradigms.

ABOUT INSTRUCTOR :

Prof. Balaraman Ravindran is currently an Professor in Computer Science at IIT Madras and Mindtree Faculty Fellow . He has nearly two decades of research experience in machine learning and specifically reinforcement learning. Currently his research interests are centered on learning from and through interactions and span the areas of data mining, social network analysis, and reinforcement learning.

COURSE PLAN :

Week 0: Probability Theory, Linear Algebra, Convex Optimization - (Recap)

Week 1: Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance

Week 2: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares

Week 3: Linear Classification, Logistic Regression, Linear Discriminant Analysis

Week 4: Perceptron, Support Vector Machines

Week 5: Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation

Week 6: Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures

Week 7: Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting

Week 8: Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks

Week 9: Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation

Week 10: Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Week 11: Gaussian Mixture Models, Expectation Maximization

Week 12: Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods, Applications)



MUNICIPAL SOLID WASTE MANAGEMENT

PROF. AJAY KALAMDHAD

Department of Civil Engineering
IIT Guwahati

INTENDED AUDIENCE : PG Level course for Environmental Engineering and UG level for Civil Engineering

INDUSTRY SUPPORT : Synergy waste management Pvt Ltd, UPL Environmental Engineers Pvt Ltd, Green power systems, A2Z group, Timarpu-Okhla waste management pvt ltd, Ramky Enviro Engineers Limited

COURSE OUTLINE :

The problems affiliated with solid waste management (SWM) in today's sprawling civilized and urbanized society are intricate because of the quantity and varied nature of wastes, the funding restriction for public disposal, interference of technology (energy and raw materials), and complex infrastructure development network in urban cities. As a result, if SWM is to achieve in consummate approach, the fundamentals aspects need to be identified. Thus, there is dire need to group the activities from the generation to the disposal point. The six different functional elements (generation, handling and separations, storage and processing at source, collection, the transformation of wastes, transfer and transport, and final disposal) for the engineering comparison and treatment need to be understood in detail. The understanding of the functional element is important because it helps in evaluating the impacts of projected changes and technological developments. Solid waste management is an essential part of every society, but it is also one of the most neglected one. An in-depth understanding of the subject is required to tackle the current solid waste management crisis effectively. This course attempts to familiarize various steps involved in solid waste management.

ABOUT INSTRUCTOR :

Prof. Ajay Kalamdhad is a Professor in the Department of Civil Engineering, Indian Institute of Technology Guwahati. He received his PhD from Indian Institute of Technology Roorkee in the year of 2008 and started working as a Lecturer in Visvesvaraya National Institute of Technology from September 2008. He joined Indian Institute of Technology Guwahati in June 2009 as an Assistant Professor. His research interests include Solid waste management, Mechanical composting and vermicomposting, Anaerobic digestion, Analysis of solid wastes, Microbiology of composting, Biosorption and Water & Wastewater Treatment. He has published numerous papers in various reputed journals. He is also the head of Waste Management Research Group (WMRG), a group that focuses on the biological treatment of various wastes.

COURSE PLAN :

Week 1: Evolution of Solid Waste Management

Week 2: Sources/Types and Characteristics of Solid Waste

Week 3: Generation of Solid Waste

Week 4: Waste Handling, Separation, storage, and Processing

Week 5: Collection of Solid Waste

Week 6: Transfer and Transport

Week 7: Separation and processing of Solid Waste

Week 8: Chemical Transformation (combustion/incineration)

Week 9: Biological Treatment (Composting)

Week 10: Biological Treatment (Anaerobic Digestion)

Week 11: Disposal of Solid Waste

Week 12: ISWM and legislation



NATURAL HAZARDS

PROF. JAVED N. MALIK

Department of Civil Engineering
IIT Kanpur

PRE-REQUISITES : Basic knowledge of Earth Science or Natural Disasters is recommended.

INTENDED AUDIENCE : PG students of Science and Engineering, Advance UG students too can take this course.

COURSE OUTLINE :

The course introduces students to natural disasters and their phenomenon, ground deformations, land-level changes, event recurrence intervals, associated environmental and depositional changes, sedimentation patterns, and all the related hazards. Some of the well-known natural disasters are earthquakes, landslides, floods, tsunamis, volcanic eruptions, storms, and cyclones etc. which cause different types of natural hazards in the associated environment and landscape. This course will emphasize their mechanism, origin, and impacts in the associated regions such as mainland, hilly terrain, floodplain/alluvial plain, and coastal regions etc., and also focus on the approaches for mitigating and minimizing hazards along with related hazard assessment.

ABOUT INSTRUCTOR :

Prof. Javed N. Malik finished his Ph. D in 1998 from M. S. University Baroda, Vadodara. Gujarat (Geology), did Post-Doctorate (Japan Society for Promotion of Science) from (1999-2001) Hiroshima University, JAPAN. Joined IIT Kanpur in 2001.

COURSE PLAN :

- Week 1:** Natural Hazards and Disasters ,Natural Hazards and Disasters ,Human Impact on Natural Disaster
- Week 2:** Mitigating Hazards,Plate Tectonics and related Hazards,Plate Tectonics and related Hazards
- Week 3:** Earthquakes and their causes,Earthquakes and their causes,Ground Motion and Failures
- Week 4:** Tsunami: Gaint Tsunamis,Tsunami: Gaint Tsunamis ,Tsunami: Generation and Movement
- Week 5:** Tsunami Hazard Assessment,Tsunami Hazard Assessment,Volcanic Hazard
- Week 6:** Landslide and their causes, Type of downslope movement, associated hazard,Landslide and their causes
- Week 7:** Floods and Human Interaction,Flood Frequency and Recurrence Interval,Flood Frequency and Recurrence Interval
- Week 8:** Storms: Tropical Cyclone,Storms: Tropical Cyclone,Hurricane, Tornado, Storm damage and safety,Wildfires



POWER QUALITY IMPROVEMENT TECHNIQUE

PROF. AVIK BHATTACHARYA

Department of Electrical and Electronics Engineering
IIT Roorkee

PRE-REQUISITES : Power Electronics

INTENDED AUDIENCE : Final year B.Tech, M.Tech students of Power Electronics and power system, Power electronics Engineer / Experts from industry

INDUSTRIES APPLICABLE TO : ABB, GE, Statcon Energeia, CESC, NTPC, NHPC all state electric supply board, AAI

COURSE OUTLINE :

The power quality of modern power distribution system is vulgarized due to the increased use of distributed sources, adjustable speed drive, nonlinear load and unbalanced load. The main challenge in the distribution system is the mitigation of power quality problems produced by load disturbances and supply disturbances. It can be mitigated by passive filters as well as active filters. The passive filters are economically cheap but their performance is poor compared to the active power filters. Hence active power filters are preferred in the modern power system.

ABOUT INSTRUCTOR :

Prof. Avik Bhattacharya is working as Assistant Professor in IIT Roorkee from February 2014. Before joining IIT Roorkee he was research and development team of Danfoss Solar inverter and ABB. He has over a decade of experience in power quality issues and published four IEEE transaction on it. He is also teaching this course in IIT Roorkee for past two years for UG and PG (B.Tech fourth year and M.Tech) . His teaching is right blending of Industry, research and academic interest

COURSE PLAN :

Week 1 : Concept of Power Quality: Frequency variations, voltage variations- sag and swell, waveform distortion –dc offset,harmonics, inter-harmonics, notching and noise.

Week 2 : Representation of harmonics, waveform, harmonic power,measures of harmonic distortion; Current and voltage limits of harmonic distortions: IEEE, IEC, EN, NORSO

Week 3 : Causes of Harmonics: 2-pulse, 6-pulse and 12-pulse converter configurations, input current waveforms and their harmonic spectrum; Input supply harmonics of AC regulator, integral cycle control, cycloconverter, transformer, rotating machines, ARC furnace, TV and battery charger.

Week 4 : Elimination/ Suppression of Harmonics: High power factor converter, multi-pulse converters using transformer connections (delta, polygon)

Passive Filters: Types of passive filters, single tuned and high pass filters, filter design criteria, double tuned filters, damped filters and their design

Week 5 : PWM Inverter: Voltage sourced active filter, current sourced active filter, constant frequency control, constant tolerance band control,variable tolerance band control.

Week 6 : Active Power Filters: Compensation principle, classification of active filters by objective, system configuration, power circuit andcontrol strategy

Week 7 : Hybrid Shunt Active power filter: Principle of operation, analysis and modelling

Week 8 : Unified power quality conditioner, voltage source and current source configurations, principle of operation for sag, swell and flicker control



PRIVACY AND SECURITY IN ONLINE SOCIAL MEDIA

PROF. PONNURANGAM KUMARAGURU

Department of Computer Science and Engineering
IIIT Hyderabad

PRE-REQUISITES : Basic / Intermediate programming course. Understanding of Python will be necessary for the course. Should be able to quickly learn APIs, and to collect data from social networks.

INTENDED AUDIENCE : Interested students

INDUSTRIES APPLICABLE TO : Any company which is interested in social media / networks data will be interested in recruiting the students finishing the course.

COURSE OUTLINE :

With increase in the usage of the Internet, there has been an exponential increase in the use of online social media and networks on the Internet. Websites like Facebook, YouTube, LinkedIn, Twitter, Flickr, Instagram, Google+, FourSquare, Pinterest, Tinder, and the likes have changed the way the Internet is being used. However, widely used, there is a lack of understanding of privacy and security issues on online social media. Privacy and security of online social media need to be investigated, studied and characterized from various perspectives (computational, cultural, psychological, etc.). Student completing the course will be able to appreciate various privacy and security concerns (spam, phishing, fraud nodes, identity theft) on Online Social Media and Student will be able to clearly articulate one or two concerns comprehensively on one Online Social Media, this will be achieved by homework.

ABOUT INSTRUCTOR :

Prof. Ponnurangam Kumaraguru ("PK") is a Professor of Computer Science at IIIT-Hyderabad. He is a Visiting Faculty at IIT Kanpur and an Adjunct faculty at IIIT Delhi. PK is an ACM India Council Member, and Chair of the Publicity & Membership Committee of ACM India. PK is a TEDx and an ACM Distinguished & ACM India Eminent Speaker. PK received his Ph.D. from the School of Computer Science at Carnegie Mellon University (CMU). His Ph.D. thesis work on anti-phishing research at CMU contributed in creating an award-winning startup - Wombat Security Technologies, wombatsecurity.com. Wombat was acquired in March 2018 for USD 225 Million. PK was listed in the World's 2% Scientists by Stanford University in Nov 2020. He is a senate member of IIIT Una, and is on various Board of Studies / Academic Council of different institutes across the country. PK has been teaching on NPTEL for the last 5 years, with great feedback from students. He has co-authored research papers in the field of Privacy and Security in Online Social Media, Cyber Security, Computational Social Science, Social Computing, Data Science for Social Good, amongst others. PK's research work regularly gets featured on news media, including print, online, and TV within India and across the world; to list a few, BBC, CBC, CBS, CNN, Doordarshan, Economic Times, Indian Express, NBC, New Scientist, New Yorker, Reuters, Times of India, USA Today, Washington Post, and many more. PK Spear heads ACM India's programs on improving the quality of PhD students in Computing in India -- PhD Clinic & Anveshan Setu Fellowship. In his Dean's role at IITD, he managed a team of 15 faculty members and 10+ admin staff, including Associate Dean of Student Affairs, overseeing hostel, sports centre, health centre, student {well-being, clubs, mentorship program}, technical & cultural fests. He was the Founding Head of Cybersecurity Education and Research Centre (CERC) at IIIT-Delhi. PK started and successfully manages PreCog (precog.iiitd.edu.in), a research group at IIIT-Delhi and IIIT Hyderabad. In addition to his contributions to academia, PK is on advisory role on various government organizations, government committees, including a 8 member committee on Non-Personal Data by Government of India, chaired by Mr. Kris Gopalakrishnan.

COURSE PLAN :

Week 1: What is Online Social Networks, data collection from social networks, challenges, opportunities, and pitfalls in online social networks, APIs

Week 2: Collecting data from Online Social Media.

Week 3: Trust, credibility, and reputations in social systems

Week 4: Trust, credibility, and reputations in social systems, cont'd

Week 5: Online social Media and Policing

Week 6: Information privacy disclosure, revelation and its effects in OSM and online social networks

Week 7: Phishing in OSM & Identifying fraudulent entities in online social networks

Week 8: Refresher for all topics

Week 9 to 12 : Research paper discussion



PROBLEM SOLVING THROUGH PROGRAMMING IN C

PROF. ANUPAM BASU

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : BE/BTech in all disciplines BCA/MCA/M. Sc

INDUSTRIES APPLICABLE TO : All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Use arrays, pointers and structures to formulate algorithms and programs
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration

ABOUT INSTRUCTOR :

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing. Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN :

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching

Week 3: Conditional Branching and Iterative Loops

Week 4: Arranging things : Arrays

Week 5: 2-D arrays, Character Arrays and Strings

Week 6: Basic Algorithms including Numerical Algorithms

Week 7: Functions and Parameter Passing by Value

Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

Week 10: Structures and Pointers

Week 11: Self-Referential Structures and Introduction to Lists

Week 12: Advanced Topics



PROGRAMMING IN JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

Week 7: Multithreaded Programming

Week 8: Java Applets and Servlets

Week 9: Java Swing and Abstract Windowing Toolkit (AWT)

Week 10: Networking with Java

Week 11: Java Object Database Connectivity (ODBC)

Week 12: Interface and Packages for Software Development



PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE : Students in any branch of mathematics/science/engineering, 1st year

PRE-REQUISITES : School level mathematics.

INDUSTRIES APPLICABLE TO : This course should be of value to any company requiring programming skills.

COURSE OUTLINE :

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

COURSE PLAN:**Week 1:**

Informal introduction to programming, algorithms and data structures

Downloading and installing Python

gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions

Week 2:

Python: types, expressions, strings, lists, tuples

Python memory model: names, mutable and immutable values

List operations: slices etc

Binary search

Inductive function definitions: numerical and structural induction

Elementary inductive sorting: selection and insertion sort

In-place sorting

Week 3:

Basic algorithmic analysis: input size, asymptotic complexity, $O()$ notation

Arrays vs lists

Merge sort

Quicksort

Stable sorting

Week 4:

Dictionaries

More on Python functions: optional arguments, default values

Passing functions as arguments

Higher order functions on lists: map, iter, list comprehension

Week 5:

Exception handling

Basic input/output

Handling files

String processing

Week 6:

Backtracking: N Queens, recording all solutions

Scope in Python: local, global, nonlocal names

Nested functions

Data structures: stack, queue

Heaps

Week 7:

Abstract datatypes

Classes and objects in Python

"Linked" lists: find, insert, delete

Binary search trees: find, insert, delete

Height-balanced binary search trees

Week 8:

Efficient evaluation of recursive definitions: memoization

Dynamic programming: examples

Other programming languages: C and manual memory management

Other programming paradigms: functional programming



PROJECT PLANNING & CONTROL

PROF. KOSHY VARGHESE

Department of Civil Engineering
IIT Madras

INTENDED AUDIENCE : UG/PG/Industry Participants

PRE-REQUISITES : Basic Mathematics with Probability & Statistics

INDUSTRIES APPLICABLE TO : All leading construction companies.

COURSE OUTLINE :

This course will cover the basic concepts in Project Planning and Control with a focus on construction projects. The course is relevant to Civil Engineering senior level undergraduate as well as post-graduate students in the area of construction management. Practicing engineers who are part of the planning team on construction projects will also benefit from the concepts covered in the course.

ABOUT INSTRUCTOR :

Prof. Koshy Varghese is a Professor with the Building Technology & Construction Management Division of Department of Civil Engineering, Indian Institute of Technology Madras (IITM). Prof. Varghese earned his Doctoral Degree at the University of Texas at Austin in 1992 and worked as a Post-Doctoral Fellow for a year after which he joined IIT Madras. Prof. Varghese is a pioneer in construction management education and research in India and He has received numerous academic honors, and he is on the editorial-board of several international journals. He is also a Member of the Board of Directors of ILCE (Institute for Lean Construction Excellence).

COURSE PLAN :

Week 01 : Introduction, Course Context, Construction Project Management

Week 02 : Time Management, Work Breakdown Structure (WBS), Gantt Charts

Week 03 : Duration Estimation, Network Representation & Analysis -1

Week 04 : Network Representation & Analysis -2; Two-Span Bridge: Scheduling, Network Analysis and Application

Week 05 : Time-Cost Trade-off (Crashing)

Week 06 : Resource Scheduling

Week 07 : Precedence Diagramming Method (PDM), Project Monitoring & Control

Week 08 : Project Monitoring & Control (Earned Value Concepts), Uncertainty in Project Schedules (PERT), Course Summary



PYTHON FOR DATA SCIENCE

PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PRE-REQUISITES : Knowledge of basic data science algorithms

INTENDED AUDIENCE : Final Year Undergraduates

COURSE OUTLINE :

The course aims at equipping participants to be able to use python programming for solving data science problems

ABOUT INSTRUCTOR :

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

COURSE PLAN :

Week 1:

BASICS OF PYTHON SPYDER (TOOL)

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

Week 2:

Sequence data types and associated operations

- Strings
- Lists
- Arrays
- Tuples
- Dictionary
- Sets
- Range

NumPy

- ndArray

Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

Data visualization on Toyota Corolla dataset using matplotlib and seaborn libraries

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

Control structures using Toyota Corolla dataset

1. if-else family
2. for loop
3. for loop with if break
4. while loop
5. Functions

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income



QUALITATIVE RESEARCH METHODS AND RESEARCH WRITING

PROF. ARADHNA MALIK
Department of Management Studies
IIT Kharagpur

TYPE OF COURSE : Rerun | Elective | PG
COURSE DURATION : 12 weeks (18 Jan' 21 - 09 Apr' 21)
EXAM DATE : 24 Apr 2021

PRE-REQUISITES : Bachelors Degree

INTENDED AUDIENCE : Interested Students

INDUSTRIES APPLICABLE TO : Education.

COURSE OUTLINE :

Qualitative research methods serve to explore the grey areas that remain outside the confines of quantitative predictive research in human behavior. Training in qualitative research is absolutely essential to understand and explore the dynamic nature of the society in which we function. This course introduces students to qualitative research and helps them understand how qualitative research supplements quantitative inquiry in human behavior and the social sciences.

ABOUT INSTRUCTOR :

Prof. Aradhna Malik earned her Masters in Child Development from Panjab University, Chandigarh, India and PhD from University of Denver, USA. She has been serving Indian Institute of Technology Kharagpur as faculty in the School of Management since 2008. Aradhna teaches intercultural communication, business ethics and organizational behavior to Undergraduate, Masters and Doctoral level students. Her research and academic interests include, ageing, orality, human technology interaction, intercultural communication, communication disorders, management of public health and neuro linguistic programming (NLP).

COURSE PLAN :

Week 1: Introduction to qualitative research, Introduction, The Qualitative Researcher

Week 2: Major paradigms & perspectives, Dominant paradigms of qualitative research, Interpretivist thinking, Verstehen

Week 3: Major paradigms & perspectives (Contd.), Critical theory, Characteristics of critical theory

Week 4: Strategies of inquiry, Introduction to qualitative inquiry, Qualitative research design

Week 5: Strategies of inquiry (Contd.), Grounded Theory, Participatory Action Research

Week 6: Methods of collecting & analyzing empirical materials, Observations, Interviewing

Week 7: Methods of collecting & analyzing empirical materials (Contd.), Analyzing talk & text

Week 8: Interpretation, evaluation & presentation, The problem of criteria, Interpretation

Week 9: What, why and how of technical and research writing.

Week 10: Literature review.

Week 11: Writing about methods, results, and discussion of results.

Week 12: Referencing, academic integrity, and writing for different types of readers



RENEWABLE ENERGY ENGINEERING: SOLAR, WIND AND BIOMASS ENERGY SYSTEMS

Prof. R. Anandalakshmi

Department of Chemical Engineering
IIT Guwahati

Prof. Vaibhav Vasant Goud

Department of Chemical Engineering
IIT Guwahati

INTENDED AUDIENCE : The target audience for this course is

1. BTech/MTech/PhD students or faculties interested in acquiring knowledge of solar, wind and biomass renewable energy systems
2. Chemical engineer/Mechanical engineer or Biosciences and Bioengineer designing renewable energy systems such as solar, wind and biomass systems
3. Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories working in the area of energy engineering.

INDUSTRIES APPLICABLE TO : All Energy Industries and Energy Equipment Manufacturing Industries

COURSE OUTLINE :

In this course an attempt has been made to standardize the course material and to emphasize on the fundamental of non-conventional energy sources (solar, wind, and biomass). Harnessing the energy through these sources using efficient technologies is expected to play an important role in serving as clean energy source for mankind. Thus, processes to harness energy are steadily gaining technical and economic importance worldwide. Therefore, it is necessary for energy planners/ users to know the facts as well as limitations of these technologies. This course aims at bringing the technological developments and research trends in the field of non-conventional energy sources with emphasis on engineering and design aspects. After attending this course students will have insight of biomass types, classifications, selective utilization of biomass resource for extraction of energy, bio-digester, wind machine and thermo-digester design.

ABOUT INSTRUCTOR :

Prof. R. Anandalakshmi is an Associate Professor in the Department of Chemical Engineering, Indian Institute of Technology, Guwahati. Her research interests are in the area of Computational Heat Transfer and Fluid Flow, Process Modeling and Simulation, Solar Thermal Energy Conversion, Energy Efficient Design of Thermal Systems, Microwave Assisted Food and Material Processing, Food Packaging and Preservation, Refrigeration and Air-conditioning Systems

Prof. Vaibhav V. Goud is Professor in the Department of Chemical Engineering, Indian Institute of Technology Guwahati, India since 2018. Principal research interests of Dr. Goud are in the fields of reaction engineering, renewable energy, supercritical fluids, bio lubricants. He has published more than 120 papers in international peer reviewed journals and made presentations of his research in several national/ international conferences. He has also written 14 book chapters in the area of renewable energy. He has taught energy resources as an elective course to UG, PG and Ph.D. students at IIT Guwahati for six consecutive years (2014, 2015, 2016, 2017, 2018 and 2019).

COURSE PLAN :

Week 1: Solar Energy: Basics and Concepts

Week 2: Non-Concentrating Solar Collectors

Week 3: Non-Concentrating Solar Collectors : Practice Problems

Week 4: Concentrating Solar Collectors

Week 5: Storage Systems

Week 6: Biomass types and characterization

Week 7: Biochemical conversion processes

Week 8: Biochemical conversion processes (Contd.)

Week 9: Bioconversion of substrates into alcohol and thermo-chemical conversion of biomass

Week 10: Bioconversion of substrates into alcohol and thermo-chemical conversion of biomass (Contd.)

Week 11: Wind Energy: Basics: Turbine terms, types and theories

Week 12: Characteristics and Power Generation from Wind Energy



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Software Testing

By Prof. Meenakshi D'souza | IIIT Bangalore

Learners enrolled: 15572

Software Testing _ Course Introduction



ABOUT THE COURSE :

This course will cover various techniques for test case design, as used for testing of software artifacts including requirements, design and code. We will discuss algorithms and techniques for test case design based on graphs, logic, syntax of programming

Summary

Course Status :	Completed
Course Type :	Elective
Duration :	12 weeks
Category :	Computer Science and Engineering
Credit Points :	3
Level :	Undergraduate/Postgraduate
Start Date :	25 Jul 2022
End Date :	14 Oct 2022
Enrollment	08 Aug 2022
Ends :	
Exam Date :	30 Oct 2022 IST





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INTENDED AUDIENCE: Any Interested Learners

PRE-REQUISITES: Programming, Algorithms, Discrete Mathematics (basics)

(<https://swayam.gov.in/c-details/NPTEL>)

INDUSTRY SUPPORT: The material of this course has been used to offer training for Samsung, ABB and Mindtree. The course will be useful for any firm that does tests their software.

inputs. Special techniques for testing object-oriented features and web

so be discussed. The course will end with a project. About Swayam (<https://swayam.gov.in/about>)

cover test cases for both white-box and black-box.

Note: This exam date is subjected to change based

on seat availability. You can check final exam date()

on your hall ticket.

This is an AICTE approved FDP course

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(https://www.addtoany.com/share?url=https%3A%2F%2Fonlinecourses.nptel.ac.in%2Fnoc22_cs61%2Fpr%20Course)

Course layout

Week 1: Techniques and algorithms for test case design: Graphs based testing- structural coverage criteria.

Week 2: Graphs based testing: Data flow coverage criteria

Week 3: Graphs based testing: Data flow coverage criteria

Week 4: Graphs coverage for source code, design elements and requirements

Week 5: Techniques and algorithms for test case design: Logic based testing- Predicates, logic based coverage criteria

Week 6: Specification based logic coverage, logic coverage on finite state machines

Week 7: Input space partitioning: Input domain modeling, combination strategies criteria

Week 8: Syntax based testing: Coverage criteria based on syntax, mutation testing

Week 9: Test case design (as learnt above) applied to object-oriented applications

Week 10: Test case design (as learnt above) applied to web applications

Week 11: Symbolic testing

Week 12: Concolic testing, Conclusion





References

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(<https://swayam.gov.in/>)



Instructor bio

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**Prof. Meenakshi
D'souza**

IIIT Bangalore

Prof. Meenakshi D'souza is currently an Associate Professor at IIIT-Bangalore. Meenakshi did her Master TMs in Mathematics from University of Madras, Chennai and her Ph. D. in Theoretical Computer Science from The Institute of Mathematical Sciences, Chennai. She joined the research department of Honeywell Technology Solutions, Bangalore soon after completing her Ph. D. and worked there in the areas of Formal Verification of Software Design, Model Based Development and Physical Access Control before joining IIIT-Bangalore. Her research interests are in Formal Methods, Model Based Development, Software Testing and Automata Theory.

Course certificate

The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: **30 October 2022** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

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CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12





in the course.

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Final score = Average assignment score + Exam score



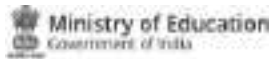
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SCORE >= 10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you
will not get the certificate even if the Final score >= 40/100.**

Certificate will have your name, photograph and the score in the final exam with the
breakup.It will have the logos of NPTEL and IIT Madras .It will be e-verifiable at
nptel.ac.in/noc (<http://nptel.ac.in/noc>).

Only the e-certificate will be made available. Hard copies will not be dispatched.

Once again, thanks for your interest in our online courses and certification. Happy
learning.

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INTENDED AUDIENCE: Any Interested Learners

PRE-REQUISITES: Programming, Algorithms, Discrete Mathematics (basics)

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References

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Instructor bio

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**Prof. Meenakshi
D'souza**

IIIT Bangalore

Prof. Meenakshi D'souza is currently an Associate Professor at IIIT-Bangalore. Meenakshi did her Master TMs in Mathematics from University of Madras, Chennai and her Ph. D. in Theoretical Computer Science from The Institute of Mathematical Sciences, Chennai. She joined the research department of Honeywell Technology Solutions, Bangalore soon after completing her Ph. D. and worked there in the areas of Formal Verification of Software Design, Model Based Development and Physical Access Control before joining IIIT-Bangalore. Her research interests are in Formal Methods, Model Based Development, Software Testing and Automata Theory.

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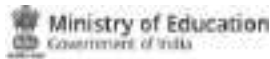
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Strength Of Materials - IITM

Prof. K. Ramesh

Department of Mechanical Engineering
IIT Madras

INTENDED AUDIENCE: Undergraduate students and practicing engineers/scientists from mechanical sciences Industries and Research laboratories

PREREQUISITES: Engineering Mechanics

INDUSTRY SUPPORT: All Mechanical, Aerospace and Structural Design Industries dealing with structural design would require this

COURSE OUTLINE:

The course will cover the basics of mechanics of deformable solids undergoing small deformations. The syllabus includes: Concepts of state of stress, strain and stress-strain and stress-strain-temperature relations. Exposure to experimental evaluation of stresses by photoelasticity and strain gauges. Stresses developed in torsion, bending, and shear-stresses in bending for slender members. Exposure to unsymmetrical bending and shear center. Bending deflection by various methods with particular emphasis to method of superposition. Stability of columns. Concepts of stress concentration, stress intensification and theories of failures. Extensive use of animations with supportive experimental results will be the unique feature of the course

ABOUT THE INSTRUCTOR:

Prof .K. Ramesh is currently the K Mahesh Chair Professor at the Department of Applied Mechanics, IIT Madras; and formerly a Professor at the Department of Mechanical Engineering, IIT Kanpur. He has made significant contributions to the advancement of Digital Photoelasticity. He received his undergraduate degree in Mechanical Engineering from the Regional Engineering College, Trichy (now NIT, Trichy), Postgraduate degree from the Indian Institute of Science, Bangalore and the Doctoral Degree from the Indian Institute of Technology Madras.

He has made significant contributions to the advancement of Digital Photoelasticity. This has resulted in a Monograph on Digital Photoelasticity Advanced Techniques and Applications (2000), Springer, a chapter on Photoelasticity in the Springer Handbook of Experimental Solid Mechanics (2009), a chapter on Digital Photoelasticity in the book on Digital Optical Measurement Techniques and Applications (2015), Artech House London and a recently published book on Developments in Photoelasticity - A renaissance (2021), IOP Publishing, UK. He has over 190 publications to date of which two have been reproduced in the Milestone Series of SPIE. His research has been funded by organizations such as ARDB, ISRO, DST, EU (FP7) and NSF. He received the Zandman award for the year 2012, the first Indian to receive it since its inception in 1989, instituted by the Society for Experimental Mechanics, USA for his outstanding research contributions in applications utilizing photoelastic coatings.

He has been a Fellow of the Indian National Academy of Engineering since 2006. He received several awards such as Distinguished Alumnus Award of NIT, Trichy (2008), President of India Cash Prize (1984). He has been a member of the Editorial Boards of the International Journals: Strain (since 2001), Journal of Strain Analysis for Engineering Design (2009–10), Optics and Lasers in Engineering, and a steering committee member of Asian Society for Experimental Mechanics since its inception in 2000.

For Details See: <https://home.iitm.ac.in/kramesh>



THE JOY OF COMPUTING USING PYTHON

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

INTENDED AUDIENCE : Any interested audience

PREREQUISITES : 10th standard/high school

INDUSTRY SUPPORT : Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!



ADVANCED CONCEPTS IN FLUID MECHANICS

PROF. SUMAN CHAKRABORTY
PROF. ADITYA BANDOPADHYAY
IIT Kharagpur
Mechanical Engineering

TYPE OF COURSE : New | Core | UG
COURSE DURATION : 12 weeks (29 Jul'19 - 18 Oct'19)
EXAM DATE : 16 Nov 2019

INTENDED AUDIENCE : B. Tech/M. Tech/MS/B.Sc./M.Sc./PhD students of all disciplines and teachers of undergraduate Fluid Mechanics

INDUSTRIES APPLICABLE TO : Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others)

COURSE OUTLINE :

This is a course which deals with advanced concepts in Fluid Mechanics. The course emphasizes the fundamental in underlying fluid mechanical principles and application of those principles to solve real life problems. There is a well-balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance.

ABOUT INSTRUCTOR :

Prof. Suman Chakraborty is a Professor in the Mechanical Engineering Department of the Indian Institute of Technology (IIT) Kharagpur, India, and Indian National Academy of Engineering Chair Professor. He is also currently the Head, School of Medical Science and Technology at IIT Kharagpur. He has research interests in the area of Microfluidics and MicroNano scale transport processes, including their theoretical, computational, and experimental modeling, encompassing the underlying fundamentals as well as bio-medical.

Prof. Aditya Bandopadhyay is currently an Assistant Professor in the Mechanical Engineering Department at Indian Institute of Technology Kharagpur, India. His research interests include micro- and nanofluidics, transport through porous media, and electrohydrodynamics. He completed his Dual Degree from IIT Kharagpur (Institute Silver Medal) in 2012 and received his Ph.D. from IIT Kharagpur in 2015.

COURSE PLAN :

Week 1: Essential Mathematical Foundations

Week 2: Kinematics of Fluid Flows

Week 3: Dynamics of Inviscid Flows

Week 4: Potential Flows

Week 5: Integral forms of Conservation Equations: Reynolds Transport Theorem

Week 6: Dynamics of Viscous Flows: Derivation of Navier-Stokes Equation

Week 7: Exact Solutions of Navier-Stokes Equations for Fully Developed Laminar Flows and some Unsteady Flows

Week 8: Laminar Boundary Layers

Week 9: Instability; Introduction to Turbulence

Week 10: Turbulence (contd.); Fluid flow about Immersed bodies

Week 11: Geophysical Fluid Dynamics

Week 12: Creeping Flows; Microscale Fluid Flows



NATURE AND PROPERTIES OF MATERIALS- AN INTRODUCTORY COURSE

PROF. ASHISH GARG

Department of Sustainable Energy Engineering
IIT Kanpur

PRE-REQUISITES : 12th standard science background

INTENDED AUDIENCE : UG and PG students of science and engineering of non-materials related background.

INDUSTRY SUPPORT : Materials related companies

COURSE OUTLINE :

The course is first part of the broader course on Introduction to Nature of materials and would be suitable for undergraduate and postgraduate students of every branch of science and engineering. The first part of this course will focus on essentials of crystallography, crystal structures of different classes of materials, structure determination and defects in materials.

ABOUT INSTRUCTOR :

Prof. Ashish Garg is Professor of Materials Science and Engineering at IIT Kanpur. Details of his research and teaching can be accessed on home.iitk.ac.in/~ashishg/

COURSE PLAN :

Week 1 : Introduction and Basic crystallography

Week 2 : Symmetry

Week 3 : Crystal Systems, Bravais Lattices and Miller Indices, Interstices

Week 4 : Structure of Metals and Alloys

Week 5 : Structure of Ceramics

Week 6 : Structure of Polymers

Week 7 : Structure Determination: X-ray diffraction

Week 8 : Defects in Materials



AN INTRODUCTION TO PROGRAMMING THROUGH C++

PROF. ABHIRAM G. RANADE

Department of Computer Science
IIT Bombay

TYPE OF COURSE : Rerun | Core | UG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 24 Apr 2022

PRE-REQUISITES : Standard XII in the Science stream.

INTENDED AUDIENCE : First and second year students in degree programs including Engineering and Science degree programs.

INDUSTRIES APPLICABLE TO : Basic programming is of value to all. C++ allows you to design very fast programs and access low level machine features, but at the same time its libraries provide a very high level programming model. It can be considered a modern, safer version of the C language.

COURSE OUTLINE :

This course provides an introduction to problem solving and programming using the C++ programming language. The topics include: Basic programming notions. Control flow, variables and assignments state-ments, conditional execution, looping, function calls including recursion. Arrays and structures. Elementary aspects of classes. Heap memory. Program design. How human beings solve problems manually. Strategies for translating manual strategies to computer programs. Organizing large programs into units such as functions and classes. Introduction to assertions and invariant. Programming applications. Arithmetic on polynomials, matrices. Root finding. Sorting and searching. Design of editors and simulators, including graphical editors. Elementary animation. A rudimentary graphics system will be discussed. Standard Library of C++. The string, vector and map classes.

ABOUT INSTRUCTOR :

Prof. Abhiram G. Ranade is a Professor of Computer Science and Engineering at IIT Bombay. He obtained a B. Tech. degree in Electrical Engineering from IIT Bombay in 1981. In 1988 he obtained a Ph.D. in Computer Science from Yale University, USA. He was an Assistant Professor of Electrical Engineering and Computer Science at the University of California, Berkeley, USA during 1988-94. Since 1995 he has been a faculty member in IIT Bombay. His research interests are Algorithms, Combinatorial Optimization, Scheduling in Transportation Systems, and Programming Education. He has won Excellence in Teaching Awards of IIT Bombay in 2006-7 and 2010-11.

COURSE PLAN :

Week 1: Introduction to computers using graphics. Notions of program organization, control flow.

Week 2: Basic data types. Variables. Assignment statement. Introduction to program design using examples such as summing infinite series.

Week 3: Statements of C++ for conditional execution and looping.

Week 4: Applications such as computing mathematical functions, root finding.

Week 5: Functions. Parameter passing. Recursion. Correctness issues.

Week 6: Recursive algorithms and recursive drawings. Breaking larger programs into functions.

Week 7: Arrays. Basic array processing strategies including passing arrays to functions. Pointers. Applications illustrating use of arrays to store sets and sequences. Iterating over pairs of objects from an array, Selection sort.

Week 8: Use of arrays to represent textual data. Multidimensional arrays. Command line arguments. Binary search. Merge sort.

Week 9: Structures. Pointers with structures. Structure examples.

Week 10: Dynamic memory allocation. Basic mechanisms and pitfalls.

Week 11: Use of the standard library in designing programs. Design of medium size programs.

Week 12: A program for designing and solving resistive circuits with a graphical user interface.



C PROGRAMMING AND ASSEMBLY LANGUAGE

PROF. JANAKIRAMAN VIRARAGHAVAN

Department of Computer Science and Engineering
IIT Madras

PRE-REQUISITES : Students are expected to have done a course on C programming and Microprocessors

INDUSTRIES APPLICABLE TO : Almost all software companies and many hardware companies

INTENDED AUDIENCE: Any Interested Learners

COURSE OUTLINE :

Students who complete their bachelors degree (BE/ BTech) in computer science or electrical engineering do extensive course work in Microprocessors and then in C programming. However, what is missing in the current curriculum is to explicitly establish the link between the two. Specifically we look at how a C program is translated to assembly language and how it eventually gets executed on a microprocessor. Through, animations we show what happens in the stack, data and code segment, of the microprocessor when a C program is executed.

ABOUT INSTRUCTOR :

Prof. Janakiraman Viraraghavan is an assistant professor at the Department of Electrical Engineering, IIT Madras and is part of the Integrated Circuits and Systems (ICS) group. His research interests include porting machine-learning algorithms on to hardware and statistical analysis in VLSI. He also has a keen interest in Microprocessors and Programming in general.

COURSE PLAN :

WEEK 1: Introduction to Microprocessors and Assembly language Programming

- Microprocessor Architecture
- Machine Language Execution sequence in a MuP
- Memory in a microprocessor
- Instruction Set
- ADDRESSING SCHEMES
- MOV
- ARITHMETIC AND LOGICAL INSTRUCTIONS
- FLAG REGISTER
- STACK INSTRUCTIONS
- CALL and RET
- HARDWARE LOOPS

WEEK 2: Introduction to C and Inline Assembly

- Data types and their sizes
- Simple examples of Inline assembly
- ALU operations
- String length
- Multiplication using repeated addition
- Swap two variables in C
- Swap two variables in inline Assembly
- Function to swap two variable in C
- Inline code to swap the two variables using a function

WEEK3: Compiling C to Assembly Language

- Compiling a simple program to Assembly – first order
- Passing parameters
- Prologue
- Epilogue
- Local variables

WEEK4: C++ and Some special Functions

- C and C++ at assembly language level
- Recursion vs Loops with factorial as example
- Special functions
- memcpy
- strlen



Cloud Computing

Prof. Soumya Kanti Ghosh

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : CSE,ECE,EE

PREREQUISITES : Basics of Computer Architecture and Organization, Networking

INDUSTRY SUPPORT : IT industries

COURSE OUTLINE:

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

ABOUT THE INSTRUCTOR:

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

COURSE PLAN:

- Week 1:** Introduction to Cloud Computing
- Week 2:** Cloud Computing Architecture
- Week 3:** Service Management in Cloud Computing
- Week 4:** Data Management in Cloud Computing
- Week 5:** Resource Management in Cloud
- Week 6:** Cloud Security
- Week 7:** Open Source and Commercial Clouds, Cloud Simulator
- Week 8:** Research trend in Cloud Computing, Fog Computing
- Week 9:** VM Resource Allocation, Management and Monitoring
- Week 10:** Cloud-Fog-Edge enabled Analytics
- Week 11:** Serverless Computing and FaaS Model
- Week 12:** Case Studies and Recent Advancements



CONTROL SYSTEMS

PROF. C.S. SHANKAR RAM

Department of Design Engineering
IIT Madras

INTENDED AUDIENCE : Undergraduate engineering students (electrical engineering, electronics engineering, mechanical engineering, aerospace engineering, chemical engineering, automobile engineering)

PRE-REQUISITES : 2nd year undergraduate students in engineering. Prefer that they have completed a course on engineering mathematics that teaches complex variables and Laplace transform.

INDUSTRIES APPLICABLE TO : Automotive companies

COURSE OUTLINE :

Course Objective: To provide a basic understanding of the concepts and techniques involved in designing control schemes for dynamic systems. Learning Outcomes: At the end of this course, one should possess in-depth knowledge of concepts from classical control theory, understand the concept of transfer function and use it for obtaining system response, analyze dynamic systems for their stability and performance, and design controllers (such as Proportional-Integral-Derivative) based on stability and performance requirements.

ABOUT INSTRUCTOR :

Prof. C. S. Shankar Ram is currently a professor in the Department of Engineering Design, Indian Institute of Technology Madras, Chennai, India. He received his Bachelor of Engineering (B. E.) in Mechanical Engineering from Motilal Nehru Regional Engineering College, Allahabad, India, and his M. S. and Ph. D. from Texas A&M University, USA. His research interests are in the areas of dynamics and control with applications to automotive and transportation systems. He teaches courses on Control Systems, Fundamentals of Automotive Systems and Control of Automotive Systems at IIT Madras.

More details can be found at: <https://ed.iitm.ac.in/~shankarram/>

COURSE PLAN :

Week 01 : Introduction to Control, Classification of Dynamic Systems, Closed Loop Control System with Feedback, Mathematical Preliminaries – Complex Variables, Laplace Transform.

Week 02 : Standard Inputs, Free and Forced Response, Transfer Function, Poles and Zeros.

Week 03 : Response to various Inputs, Effect of Poles, Notion of Bounded Input Bounded Output (BIBO) stability.

Week 04 : Effect of Zeros, Closed Loop Transfer Function, Dynamic Performance Specification, First Order Systems.

Week 05 : Second Order Systems, Unit Step Response of Underdamped Second Order Systems, Concepts of Rise Time, Peak Time, Maximum Peak Overshoot and Settling Time.

Week 06 : Controllers – Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design.

Week 07 : Routh's Stability Criterion, Use in Control Design, Incorporation of Performance Specifications in Controller Design, Analysis of Steady State Errors.

Week 08 : Root Locus and its Application in Control Design.

Week 09 : Frequency Response, Bode Plots, Nyquist Plots.

Week 10 : Nyquist Stability Criterion, Relative Stability – Gain and Phase Margins.

Week 11 : Control System Design via Frequency Response – Lead, Lag and Lag-Lead Compensation.

Week 12 : Case Studies.



DATA BASE MANAGEMENT SYSTEM

PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering
IIT Kharagpur

PROF. SAMIRAN CHATTOPADHYAY

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Procedural and / or Object-Oriented Programming (C / C++ / Java / Python), Data Structures, Algorithms

INTENDED AUDIENCE : Students from all disciplines can enroll for this course.

INDUSTRIES APPLICABLE TO : DBMS is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems, data mining, machine learning) have a need for the same. These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

COURSE OUTLINE :

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. Consequently, Oracle, Microsoft SQL Server, Sybase etc. have emerged as leading commercial systems while MySQL, PostgreSQL etc. lead in open source and free domain.

While DBMS's differ in the details, they share a common set of models, design paradigms and a Structured Query Language (SQL). In this background the course examines data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation. More specifically, the course introduces relational data models; entity-relationship modeling, SQL, data normalization, and database design. Further it introduces query coding practices using MySQL (or any other open system) through various assignments. Design of simple multi-tier client / server architectures based and Web-based database applications is also introduced.

ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Prof. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (<https://www.facebook.com/t10kt.algorithms/>) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

Prof. Samiran Chattopadhyay obtained his B Tech and M Tech degree in 1987 and 1989 respectively from IIT Kharagpur. He obtained his PhD degree from Jadavpur University in 1993. He served as a faculty in the Department of Computer Science and Engineering, Jadavpur University from 1989 to 1993. In 1993, he moved to industry and joined back the same department in Jadavpur University as an Associate Professor in 1997. Since 2001, he is a Professor of Information Technology in Jadavpur University.

Prof. Chattopadhyay is also a visiting fellow of the University of Northumbria, Newcastle upon Tyne UK. He was an adjunct faculty at IIT Kharagpur for the Distributed Systems course and a visiting faculty member for the MTech course by IIT Kharagpur which was offered in distance learning mode.

Dr. Chattopadhyay has more than two decades of experience of serving reputed Industry houses including Mindware, Computer Associates TCG Software, Interra Systems India Ltd. He is also a project consultant of the prestigious National Digital Library Mission of Government of India.

Prof. Chattopadhyay has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Ad hoc Wireless Networks, Cloud Computing. Dr. Chattopadhyay has been a co-faculty in Database Management Systems in NPTEL-NOC.

Prof. Chattopadhyay has published over 60 technical papers in international journals in the areas of Wireless Networks, Network Security, Machine learning applications. He has co-authored a research monograph titled 'Digital Geometry in Image Processing', a textbook titled 'Data Structures through C' and 'Big Data in e-Healthcare'. His current research interests include Network Security, Machine learning, Wireless network and Pervasive computing.

COURSE PLAN :

Week 1: Course Overview, Introduction to RDBMS

Week 2: Structured Query Language (SQL)

Week 3: Relational Algebra, Entity-Relationship Model

Week 4: Relational Database Design

Week 5: Application Development, Case Studies, Storage and File Structure

Week 6: Indexing and Hashing, Query Processing

Week 7: Query Optimization, Transactions (Serializability and Recoverability)

Week 8: Concurrency Control, Recovery Systems, Course Summarization



DESIGN FOR QUALITY, MANUFACTURING AND ASSEMBLY

PROF. SARAVANA KUMAR

Department of Mechanical Engineering
IIT Madras

PROF. PALANIAPPAN RAMU

Department of Mechanical Engineering
IIT Madras

TYPE OF COURSE : New | Elective | UG/PG

INTENDED AUDIENCE : B.E/B.Tech, M.E/M.Tech,
M.S, B.Sc, M.Sc, PhD

COURSE DURATION : 8 weeks (29 Jul'19 - 20 Sep'19)

EXAM DATE : 29 Sep 2019

INDUSTRIES APPLICABLE TO : Fiat Chrysler Automotive, Daimler India, Cyient, Saint Gobain

COURSE OUTLINE :

In the context of product design, it is very important to appreciate the limitations of a design from manufacturing and assembly perspective and to produce high quality products at low cost. This course will introduce methods that can provide guidance to design teams in simplifying product structure to reduce manufacturing and assembly costs, quantify improvements and how robust design concepts can be used for ensuring quality. This course aims at introducing the need to account for variability, mathematically represent it, formulate it and control it. Concepts such as quality, robustness, six sigma and orthogonal array will be discussed.

ABOUT INSTRUCTOR :

Prof. Saravana Kumar is interested in development of representational and computational tools for virtual and physical prototyping applied to arrive at solutions to design problems. Some of the specific research areas include CAD and 3D data acquisition technologies: geometrical modelling schemes, X-ray tomography, photogrammetry and image-based modelling systems, and rapid prototyping.

Prof. Palaniappan Ramu research interest revolves around optimization and treating uncertainties in product and process design to obtain reliable, robust and quality designs. Most of his work is focused on reduction of computer or physical experiments, building better metamodels, intelligently explore design space and enable better predictions and optimal designs under uncertainties.

COURSE PLAN :

Week 01 : Introduction, course expected outcomes, discussion on quality

Week 02 : Measuring quality: Quality loss function. Discussion on robustness, six sigma concepts

Week 03 : Quantifying robustness: Signal to Noise Ratio, problem formulation using SNR. Design of experiment discussions

Week 04 : Orthogonal array, linear graphs, triangular tables, finding optimum combinations. Case studies

Week 05 : Design for Manufacturing: over the wall design, most influential phase in design, best practices in injection molding and sheet metal working

Week 06 : Design for additive manufacturing, single point and multipoint tools

Week 07 : Design for Assembly: Boothroyd Dewhurst method, theoretical minimum number of parts, Xerox producibility index (XPI) method

Week 08 : Do's and don'ts in manual assembly, assembly time estimation, design for robotic assembly considerations. Design for sustainability



DESIGN OF FIXED WING UNMANNED AERIAL VEHICLES

PROF. SADERLA SUBRAHMANYAM

Department of Aerospace Engineering
IIT Kanpur

PRE-REQUISITES : Introduction to Aerodynamics

INTENDED AUDIENCE : Undergraduate and postgraduate students

INDUSTRIES APPLICABLE TO : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin

COURSE OUTLINE :

This course introduces the initial designing and sizing process for rapidly growing fixed – wing UAV technology, integrated with its performance and stability analysis and prototype testing.

ABOUT INSTRUCTOR :

Prof. Subrahmanyam Saderla obtained his B.Tech (Aeronautical Engineering) from JNTU, Hyderabad in 2008, M.Tech and Ph.D (Aerospace Engineering) from IIT Kanpur during 2010 and 2015 respectively. Later he joined as a postdoctoral fellow in the department of aerospace and software engineering at Gyeongsang National University (GNU), South Korea. At present he is working as an Assistant Professor in the Department of Aerospace Engineering at Indian Institute of Technology Kanpur. His current area of interest lies in real time system identification of unmanned aerial vehicles. His research interests also include design, flight tests and parameter estimation, high angle of attack aerodynamic modelling and dynamic wind tunnel testing as well as experimental flight dynamics, chaotic modelling (of cancer cell growth, seismic data & material properties etc.) using Artificial Neural Networks.

COURSE PLAN :

Week 01 : Introduction to fixed-wing UAVs, Introduction to Design, Basic Design Parameters.

Week 02 : Basic Design Parameters contd., Design Algorithm: Case Study, Design Algorithm: Mission Requirements.

Week 03 : Design Algorithm: Feasible Design Parameters, Configuration Layout: Airfoil Selection Configuration Layout: Planform Geometry selection

Week 04 : Weight and CG Estimation Analytical Parameter Estimation Analytical Parameter Estimation contd.

Week 05 : Performance and Stability Analysis Performance and Stability Analysis contd. Performance and Stability Analysis contd.

Week 06 : Simulation, Simulation contd..., Detailed Sizing

Week 07 : Estimation of inertial properties using 3D modelling, Prototype Fabrication

Week 08 : Wind Tunnel Testing, Aerodynamic Characterization through Wind Tunnel Testing



DESIGN OF REINFORCED CONCRETE STRUCTURES

PROF. NIRJHAR DHANG

Department of Civil Engineering
IIT Kharagpur

INTENDED AUDIENCE : Students of Civil Engineering and Architecture

INDUSTRIES APPLICABLE TO : This course will be recognized by design consultancy firms and construction industries.

COURSE OUTLINE :

Design of reinforced concrete structures is an introductory design course in civil engineering. In this course, basic elements governed by bending, shear, axial forces or combination of them are identified and are considered as building blocks of the whole structure. Different methods of design will be briefly described before introducing the limit states of collapse and serviceability. The design will be done as per IS 456:2000

ABOUT INSTRUCTOR :

Prof. Nirjhar Dhang (born 1962) is currently Professor of the Department of Civil Engineering, Indian Institute of Technology, Kharagpur, where he teaches Bridge Engineering, Structural Health Monitoring & Control, Design of Reinforced Concrete Structures. He works in the field of structural engineering particularly in the area of concrete, structural health monitoring & control and railway bridges applicable for high speed rail. He has done many consultancy and research project work.

COURSE PLAN :

Week 01 : Introduction, Different methods of design of reinforced concrete structures

Week 02 : Working stress method

Week 03 : Limit state of collapse - flexure

Week 04 : Design of singly reinforced beam

Week 05 : Design of doubly reinforced beam

Week 06 : Limit state of collapse - shear

Week 07 : Design for shear

Week 08 : Design of slab

Week 09 : Design of compression members

Week 10 : Design of footing

Week 11 : Design of staircase

Week 12 : Limit state of serviceability



DEVELOPING SOFT SKILLS AND PERSONALITY

PROF. T. RAVICHANDRAN

Department of Humanities and Social Sciences
IIT Kanpur

INTENDED AUDIENCE : Students, Teachers, Professionals, Trainers, Leaders, Employers

INDUSTRIES APPLICABLE TO : All industries/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

COURSE OUTLINE :

The course aims to cause a basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfillment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills.

ABOUT INSTRUCTOR :

Prof. T. RAVICHANDRAN is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad

COURSE PLAN:

Week 1: Lecture 1: Introduction: A New Approach To Learning

Lecture 2: Planning And Goal-Setting

Lecture 3: Human Perceptions: Understanding People

Lecture 4: Types Of Soft Skills: Self-Management Skills

Lecture 5: Aiming For Excellence: Developing Potential And Self-Actualisation

Lecture 6: Need Achievement And Spiritual Intelligence

Week 2: Lecture 7: Conflict Resolution Skills: Seeking Win-Win Solution

Lecture 8: Inter-Personal Conflicts: Two Examples

Lecture 9: Inter-Personal Conflicts: Two Solutions

Lecture 10: Types Of Conflicts: Becoming A Conflict Resolution Expert

Lecture 11: Types Of Stress: Self-Awareness About Stress

Lecture 12: Regulating Stress: Making The Best Out Of Stress

- Week 3:** **Lecture 13:** Habits: Guiding Principles
Lecture 14: Habits: Identifying Good And Bad Habits
Lecture 15: Habits: Habit Cycle
Lecture 16: Breaking Bad Habits
Lecture 17: Using The Zeigarnik Effect For Productivity And Personal Growth
Lecture 18: Forming Habits Of Success
- Week 4:** **Lecture 19:** Communication: Significance Of Listening
Lecture 20: Communication: Active Listening
Lecture 21: Communication: Barriers To Active Listening
Lecture 22: Telephone Communication: Basic Telephone Skills
Lecture 23: Telephone Communication: Advanced Telephone Skills
Lecture 24: Telephone Communication: Essential Telephone Skills
- Week 5:** **Lecture 25:** Technology And Communication: Technological Personality
Lecture 26: Technology And Communication: Mobile Personality?
Lecture 27: Topic: Technology And Communication: E-Mail Principles
Lecture 28: Technology And Communication: How Not To Send E-Mails!
Lecture 29: Technology And Communication: Netiquette
Lecture 30: Technology And Communication: E-Mail Etiquette
- Week 6:** **Lecture 31:** Communication Skills: Effective Communication
Lecture 32: Barriers To Communication: Arising Out Of Sender/Receiver's Personality
Lecture 33: Barriers To Communication: Interpersonal Transactions
Lecture 34: Barriers To Communication: Miscommunication
Lecture 35: Non-Verbal Communication: Pre-Thinking Assessment-1
Lecture 36: Non-Verbal Communication: Pre-Thinking Assessment-2
- Week 7:** **Lecture 37:** Nonverbal Communication: Introduction And Importance
Lecture 38: Non-Verbal Communication: Issues And Types
Lecture 39: Non-Verbal Communication: Basics And Universals
Lecture 40: Non-Verbal Communication: Interpreting Non-Verbal Cues
Lecture 41: Body Language: For Interviews
Lecture 42: Body Language: For Group Discussions
- Week 8:** **Lecture 43:** Presentation Skills: Overcoming Fear
Lecture 44: Presentation Skills: Becoming A Professional
Lecture 45: Presentation Skills: The Role Of Body Language
Lecture 46: Presentation Skills: Using Visuals
Lecture 47: Reading Skills: Effective Reading
Lecture 48: Human Relations: Developing Trust And Integrity



ECOLOGY AND ENVIRONMENT

Prof. Abhijit P Deshpande

Department of Multidisciplinary
IIT Madras

Prof. Ravi Krishna R

Department of Multidisciplinary
IIT Madras

INTENDED AUDIENCE : Any interested Learners

COURSE OUTLINE :

The objectives of the course is to introduce and sensitize all BTech students to the issue of ecology, environment and sustainability. The lectures are aimed at posing various questions that are relevant for all students of engineering and management to incorporate sustainability and a sensitivity to ecology and environment in their design of products, processes and systems.

ABOUT INSTRUCTOR :

Prof. Abhijit P. Deshpande is a Professor of Chemical Engineering at IIT Madras. His research focus is on polymeric systems, more specifically their aggregation and gelation behaviour. In his group, polymeric materials such as hydrogels and membranes are being investigated for applications in electrical, electromechanical and electrochemical devices. His teaching interests include specialized courses in polymers, fluid mechanics, rheology and continuum mechanics; and core chemical engineering courses such as mass transfer and thermodynamics

Prof. R. Ravikrishna Professor(2018 Current) Indian Institute of Technology Madras Associate Professor (2013-2018) Indian Institute of Technology Madras Assistant Professor (2006-2013) Indian Institute of Technology Madras Research Associate (2000-2006) Louisiana State University, Baton Rouge, USA

COURSE PLAN :

- Week 01 :** Dr. B.S. Murty: Introduction (1), Sustainability Definition / Goals, Climate Change (2), Case Studies (3)
(Eg: Dams, Chemicals, e-waste, IOT, Landfill siting etc)
- Week 02 :** Dr. Sudhir Chella Rajan: Sustainability and Economics (3), Sustainability and Ethics (3)
- Week 03 :** Dr. Ligy Philip (Water Quality/ Waste Management): Water Quality and Treatment (3), Waste Management and Treatment (3)
- Week 04 :** Dr. B. S. Murty (Water Management/ Resources): Urban Drainage, Water Resource Management, Impact of Climate Change
- Week 05 :** Dr. Srinivas Jayanti (Energy):Energy Demand / Resources (1), Pollution from Energy generation (1), Energy and Climate Change (Global Warming) (1), Energy and Sustainability (1), Long Range and Short Range Solutions (1), (Global vs. India)
- Week 06 :** Dr. R. Ravi Krishna: Risk Assessment Definition (1), Pollutant Pathways / Safety/ Exposure (1), Liability /Examples (1), Life Cycle Assessment (2), Environmental Management and LCA (1).
- Week 07 :** Dr. Sudhir Chella Rajan: Urban Planning / Sprawl (1), Challenges in Urban Planning,Transport (1), Energy (Smart Grid) (1), Water (1), Waste (1), Governance (1).
- Week 08 :** Dr. Susy Varughese / Dr. Parag Ravindran: Ecology – definitions / Systems (1), Biodiversity (1), Examples of Historical Impact of economy on Ecology, Restoration / Ecological Engineering.
- Week 09 :** Dr. Ligy Philip / Dr. Ravi Krishna: Solid Waste Management, Hazardous Waste Management



ENERGY CONSERVATION AND WASTE HEAT RECOVERY

PROF. PRASANTA KUMAR DAS

Department of Mechanical Engineering
IIT Kharagpur

PROF. ANANDAROOP BHATTACHARYA

Department of Mechanical Engineering
IIT Kharagpur

INTENDED AUDIENCE : Energy Science and Engineering, Mechanical Engineering, Electrical Engineering students

PRE-REQUISITES : Basic Thermodynamics

INDUSTRIES APPLICABLE TO : BHEL, NTPC, CESC, WBSEB, DVC and other power companies, GE, Siemens, Alstom

COURSE OUTLINE :

Estimates from analyses and audits from various industries suggest that 20 to 50% of industrial energy input is lost as waste heat. This waste heat can be in the form of hot exhaust gases, water/fluid streams (from condensers in power plants) or heat lost from hot equipment and surfaces. As the world strives for higher energy efficiencies, it is imperative that along with better equipment we focus on recovering the energy stored in this “waste heat” and utilize it for useful purposes. The proposed course introduces us to various methods of Waste Heat Recovery that has been employed by the industry to harness the energy stored in waste heat and use it for generation of additional electric power.

ABOUT INSTRUCTOR :

Prof. Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean Post Graduate Studies and Research at IIT Kharagpur. He possesses a vast experience in teaching and research. His research interests lie in the broad area of thermal engineering with a special emphasis on two phase flow. Apart from teaching many fundamental subjects he offered applied courses like Power Plant Engineering, Thermal System Design, Waste Heat Recovery etc. He has also conducted tailor-made courses for industries. He contributed actively in sponsored research and offered consultancy to different Government and private industries. He contributed more than 190 publications in international journals, a vast number of publications in national and international conferences and 10 patents. He has supervised more than 20 scholars for their doctoral degree. He is fellows of Indian National Academy of Engineering and National Academy of Sciences India.

Prof. Anandaroop Bhattacharya is an Associate Professor of Mechanical Engineering at IIT Kharagpur. His research interests lie in the areas of electronics cooling, transport in porous media and gas turbine heat transfer. Prior to joining IIT, Anandaroop spent 12 years in the industry in USA and India working at Intel, General Motors and General Electric Research Centers.

COURSE PLAN :

Week 1 : Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws

Week 2 : Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency

Week 3 : Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples

Week 4 : Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators

Week 5 : Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ϵ -NTU method

Week 6 : Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network

Week 7 : Heat pipes & Vapor Chambers, Direct conversion technologies –Thermoelectric Generators.

Week 8 : Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD

Week 9 : Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.

Week 10 : Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage

Week 11 : Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.

Week 12 : Energy Economics



ETHICAL HACKING

PROF. INDRANIL SENGUPTA

Dept. of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : Computer Science and Engineering / Information Technology / Electronics and Communication Engineering / Electrical Engineering

PREREQUISITES : Basic concepts in programming and networking

INDUSTRIES APPLICABLE TO : TCS, Wipro, CTS, Google, Microsoft, Qualcomm

COURSE OUTLINE

Ethical hacking is a subject that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the participants. The participants are encouraged to try and replicate the demonstration experiments that will be discussed as part of the course.

ABOUT INSTRUCTOR

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on Reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

COURSE PLAN

Week 1: Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.

Week 2: IP addressing and routing. TCP and UDP. IP subnets.

Week 3: Routing protocols. IP version 6.

Week 4: Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool.

Week 5: Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

Week 6: Introduction to cryptography, private-key encryption, public-key encryption.

Week 7: Cryptographic hash functions, digital signature and certificate, applications.

Week 8: Steganography, biometric authentication, network-based attacks, DNS and Email security.

Week 9: Packet sniffing using Wireshark and Burp Suite, password attack using Burp Suite. Social engineering attacks and Denial of service attacks.

Week 10: Elements of hardware security: side-channel attacks, physical in-lab functions, hardware trojans.

Week 11: Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution, etc. Attack on web servers: password attack, SQL injection, cross-site scripting.

Week 12: Case studies: various attack scenarios and their remedies.



INTRODUCTION TO FLUID MECHANICS

PROF. SUMAN CHAKRABORTY

Department of Mechanical Engineering
IIT Kharagpur

PRE-REQUISITES : Basic knowledge of Mathematics

INTENDED AUDIENCE : Interested students

INDUSTRIES APPLICABLE TO : Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others)

COURSE OUTLINE :

This is an introductory course in Fluid Mechanics. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. There is a well balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will have a strong fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.

ABOUT INSTRUCTOR :

Prof. Suman Chakraborty is currently a Professor in the Mechanical Engineering Department as well as an Institute Chair Professor of the Indian Institute of Technology Kharagpur, India, and the Head of the eSchool of Medical Science and Technology. He is also the Associate Dean for Sponsored Research and Industrial Consultancy. His current areas of research include microfluidics, nanofluidics, micro-nano scale transport, with particular focus on biomedical applications. He has been awarded the Santi Swaroop Bhatnagar Prize in the year 2013, which is the highest Scientific Award from the Government of India. He has been elected as a Fellow of the American Physical Society, Fellow of the Royal Society of Chemistry, Fellow of ASME, Fellow of all the Indian National Academies of Science and Engineering, recipient of the Indo-US Research Fellowship, Scopus Young Scientist Award for high citation of his research in scientific/technical Journals, and Young Scientist/ Young Engineer Awards from various National Academies of Science and Engineering. He has also been an Alexander von Humboldt Fellow, and a visiting Professor at the Stanford University. He has 380+ Journal publications.

COURSE PLAN :

Week 1: Introduction and Basic Principles

Week 2: Properties of Fluids

Week 3: Properties of Fluids and Fluid Statics

Week 4: Fluid Statics

Week 5: Fluid Kinematics (Part I)

Week 6: Fluid Kinematics (Part II)

Week 7: Dynamics of Inviscid Flows (Part I)

Week 8: Dynamics of Inviscid Flows (Part II)

Week 9: Integral Forms of Control Volume Conservation Equations (Part I)

Week 10: Integral Forms of Control Volume Conservation Equations (Part II)

Week 11: Integral Forms of Control Volume Conservation Equations (Part III); Dynamics of Viscous Flows (Part I)

Week 12: Dynamics of Viscous Flows (Part II)



FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

PROF. SHYAMANTA M. HAZARIKA

Department of Mechanical Engineering
IIT Guwahati

PRE-REQUISITES : Basic Course in Probability and Linear Algebra

INTENDED AUDIENCE : Final Year B.Tech/M.Tech and PhD students

COURSE OUTLINE :

What does automatic scheduling or autonomous driving have in common with web search, speech recognition, and machine translation? These are complex real-world problems that span across various practices of engineering! Aim of artificial intelligence (AI) is to tackle these problems with rigorous mathematical tools. The objective of this course is to present an overview of the principles and practices of AI to address such complex real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

ABOUT INSTRUCTOR :

Prof. Shyamanta M Hazarika is a Professor of Mechanical Engineering at IIT Guwahati and leads the Biomimetic Robotics and Artificial Intelligence Lab. His research interest is in Rehabilitation Robotics. This translates into interest in Artificial Intelligence, Biomimetic Robotics and Robotic Neurorehabilitation. Prior to joining IIT Guwahati, he was with the Department of Computer Science and Engineering, Tezpur University. He has been a Vertretungsprofessur of Cognitive Systems and Neuroinformatics, University of Bremen, Germany. Prof. Hazarika holds a B.E. in Mechanical Engineering from Assam Engineering College, Guwahati, India; M.Tech. in Robotics from Center for Robotics, IIT Kanpur, India. He completed his PhD in Artificial Intelligence (Knowledge Representation and Reasoning) from School of Computing, University of Leeds, England.

COURSE PLAN :

Week 1: AI and Problem Solving by Search

Week 2: Problem Solving by search

Week 3: Problem Solving by search (contd)

Week 4: Knowledge Representation and Reasoning

Week 5: Knowledge Representation and Reasoning (Contd)

Week 6: Knowledge Representation and Reasoning (contd)

Week 7: Reasoning under uncertainty

Week 8: Planning

Week 9: Planning and Decision Making

Week 10: Machine Learning

Week 11: Machine Learning (contd)

Week 12: Machine Learning (contd)



FUNDAMENTALS OF MANUFACTURING PROCESSES

PROF. D.K. DWIVEDI

Department of Mechanical and Industrial Engineering
IIT Roorkee

INTENDED AUDIENCE : Any interested learners

COURSE OUTLINE :

It is proposed to include fundamental of following aspects of manufacturing technology

A) Understanding Manufacturing: concept of manufacturing, need, scope, advantages, limitation, application, materials and manufacturing, classification of manufacturing, process capabilities, selection, break even analysis of manufacturing processes

B) Casting: approach, steps, pattern, molding, gate and riser, melt treatment, solidification, casting processes: sand mould, shell mould, permanent mould casting, casting defect and their remedy

C) Forming: approach, hot and cold forming, rolling, forging, extrusion, drawing, sheet metal forming, press, dies, types of dies and die set sheet metal operations punching, blanking, notching, nibbling

D) Joining: approach, need, principle of fusion welding, gas welding, thermit welding, arc welding common arc welding processes, resistance welding, weldability of metals, solidification of weld, weld discontinuities and their remedy

E) Machining: approach, mechanism, classification, cutting tool, tool material, heat generation, cutting fluid, grinding, internal and external surface grinding, centerless grinding designation and selection of grinding wheel, trueing and balancing, honing, reaming, lapping, polishing etc.

F) Improving properties: heat treatment of steel and aluminum alloys, Fe-C diagram, TTT diagram, and CCT diagram, heat treatment processes annealing, normalizing, quenching tempering, surface modification methods namely without change chemistry, changing chemical composition and development of coating and cladding.

ABOUT INSTRUCTOR :

Prof. D K Dwivedi obtained BE (mechanical engineering), in 1993 from GEC Rewa, ME (welding engineering) from Univ. of Roorkee in 1997 and PhD in Met. Engineering from MNIT, Jaipur in 2003. He has about 9 years teaching experience at NIT Hamirpur and 14 years at IIT Roorkee in subjects related with manufacturing at UG level and welding engineering related subjects at PG level. He has published more than 120 research papers in SCI/SCIE indexed journals and undertaken 20 sponsored research and 50 industrial consultancy projects. He has authored two books entitled Production and Properties of Cast Al-Si Alloys with New Age International, New Delhi (2013) and Surface Engineering with Springer, New Delhi (2018).

COURSE PLAN :

- Week 1 :** Understanding Manufacturing
Fundamental approaches of manufacturing
Manufacturing process specific advantages and limitation
Materials and manufacturing processes
Classification of manufacturing processes
- Week 2 :** Selection of manufacturing processes
Application of manufacturing processes
Effect of manufacturing processes on properties of metals
Break-even point analysis in manufacturing processes
Metal Casting: Introduction & Suitability
- Week 3 :** Metal Casting: Steps of casting processes
Metal Casting: Terminology
Metal Casting: Pattern allowances I
Metal Casting: Pattern allowances II
Metal Casting: Sand Moulding I

- Week 4 :** Metal Casting: Sand Moulding II
Metal Casting: Core & Core Prints
Metal Casting: Gating System
Metal Casting: Yield
Metal Casting: Riser Design
- Week 5 :** Metal Casting: Cleaning of casting
Metal Casting: Casting defects & their prevention
Metal Casting: Shell molding
Metal Casting: Investment and permanent mould casting
Metal working processes: Hot and cold working
- Week 6 :** Metal working processes: Rolling
Metal working processes: Forging
Metal working processes: Extrusion
Metal working processes: Wire Drawing
Metal working processes: Press
- Week 7 :** Metal working processing: Sheet metal operations (Shearing)
Metal working processing: Sheet metal operations II
Metal working processing: Sheet metal operations III
Metal working processing: Dies and die set
Material removal processes: Machining
- Week 8 :** Material removal processes: Mechanism of the metal cutting
Material removal processes: Chip Formation
Material removal processes: Types of chips and power consumption
Material removal processes: Heat generation
Material removal processes: Tool failure and tool life
- Week 9 :** Material removal processes: Tool materials
Material removal processes: Cutting fluids
Material removal processes: Grinding I
Material removal processes: Grinding II
Material removal processes: Grinding III
- Week 10 :** Material removal processes: Grinding operations
Joining of metals: Fundamentals I
Joining of metals: Fundamentals II
Joining of metals: Welding processes I
Joining of metals: Brazing, soldering and weldability
- Week 11 :** Joining of metals: Weldability and welding defects
Heat treatment: Fundamentals
Heat treatment: Fundamentals II
Heat treatment: Fundamentals III
Heat treatment: Normalizing and hardening
- Week 12 :** Heat treatment: Tempering
Improving surface properties: Introduction
Improving surface properties: Surface modification processes I
Improving surface properties: Changing chemical composition
Improving surface properties: Coating



HEAT EXCHANGERS: FUNDAMENTALS AND DESIGN ANALYSIS

PROF. PRASANTA KUMAR DAS

Department of Mechanical Engineering
IIT Kharagpur

PROF. INDRANIL GHOSH

Department of Cryogenic Engineering
IIT Kharagpur

INTENDED AUDIENCE : Mechanical Engineering, Chemical Engineering, Energy Engineering, Cryogenics Engineering, Aerospace Engineering etc.

PREREQUISITES : Thermodynamics, Fluid Mechanics and Heat Transfer (at a very basic level).

INDUSTRY SUPPORT : All the companies generating coal based and nuclear based power (NTPC, different state electricity boards, CPRI, BARC, and NPCL etc.). Companies dealing with the design and fabrication of heat exchangers, auto mobile industries, process industries, oil refineries. Companies dealing with waste heat recovery and renewable. Some specific companies could be BHEL, ALSTOM, HP, HPCL, IOCL, THERMAX, BPCL, GAIL, Reliance, TATA Chemicals etc.

COURSE OUTLINE :

Heat exchangers are extensively used in diverse industries covering power generation, refrigeration and air conditioning, cryogenics, oil refineries and chemical processes, automobiles and other transport devices. The performance of a heat exchanger is very important for the conservation of energy, assurance of product quality, process viability and environmental protection. The present course aims at developing a familiarity with various types of heat exchangers, their construction and applications. Conventional methods of heat exchanger analysis; brief design methodology of typical heat exchangers and synthesis of heat exchanger network. It is planned to develop an appreciation and basic expertise in heat exchanger through description, mathematical analysis and numerical examples.

ABOUT INSTRUCTOR :

Prof. Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean Post Graduate Studies and Research at IIT Kharagpur. He possesses a vast experience in teaching and research. His research interests lie in the broad area of thermal engineering with a special emphasis on two phase flow. Apart from teaching many fundamental subjects he offered applied courses like Power Plant Engineering, Thermal System Design, Waste Heat Recovery etc. He has also conducted tailor-made courses for industries. He contributed actively in sponsored research and offered consultancy to different Government and private industries. He contributed more than 190 publications in international journals, a vast number of publications in national and international conferences and 10 patents. He has supervised more than 20 scholars for their doctoral degree. He is fellows of Indian National Academy of Engineering and National Academy of Sciences India.

Prof. Indranil Ghosh received his B. Sc. and M. Sc. in Physics from Jadavpur University in 1990 and 1992 respectively, M.Tech and Ph.D. from the Cryogenic Engineering Centre, Indian Institute of Technology, Kharagpur in 1995 and 2005 respectively. With the experience of being an engineer, R&D of Bharat Heavy Plates and Vessel Ltd., Visakhapatnam and Post-Doctoral researcher in Hydrogen Research Institute, University of Quebec at Trois Rivières, he joined Indian Institute of Technology, Kharagpur as an Assistant Professor in 2006. His research interests include heat transfer in cryogenic systems, heat transfer in metal foam, compact heat exchangers, sorption cooling techniques etc. He has carried out some sponsored projects (on-going) with MHRD and CSIR. He has published 22 research papers in peer reviewed international journals, 15 papers in national and international conferences.

COURSE PLAN :

Week 1 : Background, Application, Classification, Common terminologies.

Week 2 : Introduction to Thermal and hydraulic aspects, pressure drop and heat transfer, sizing and rating. F-LMTD and -NTU method.

Week 3 : Tubular Heat Exchangers: different designs, brief description of Shell and Tube Heat Exchangers, Special types.

Week 4 : Compact heat exchangers, enhancement of heat transfer, extended surface or Fin, fundamental of extended surface heat transfer, Fin tube heat exchanger

Week 5 : Plate Fin Heat Exchangers (PFHE), types, construction, fabrication, design, application. Multistream PFHE.

Week 6 : Multistream PFHE continued. Direct contact heat exchangers, types, application, simple analysis.

Week 7 : Regenerators, types of regenerators, construction, application. Theory of Regenerator, -NTU and -method..

Week 8 : Heat pipes, construction, working principle, application, analysis. Special heat pipes.

Week 9 : Microscale Heat Exchangers and heat sinks; heat transfer and fluid flow through narrow conduits, special design considerations

Week 10 : Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.

Week 11 : Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.

Week 12 : Heat Exchanger testing, steady state and dynamic methods.

Human-Computer Interaction - Web course

COURSE SYLLABUS

HCI foundation and history; Usability life cycle and methods; Design rules and guidelines; Empirical research methods; Models in HCI - GOMS, Fitts' law and Hick-Hyman's law; Task analysis; Dialogue design; Cognitive architecture and HCI; Graphic User Interfaces & aesthetics; Usability Testing; UML, OOP, OOM; Design Case Studies.

COURSE DETAILS

Module		Lecture Details			
SL.No	Topic	No	Topic	No of Lectures	Remarks Author
M1	Introduction	L1	Course objective and overview	1	SB
		L2	Historical evolution of the field	1	SB
M2	Interactive system design (theory and practice)	L1	Concept of usability - definition and elaboration	1	PY
		L2	HCI and software engineering	1	SB
		L3	GUI design and aesthetics	1	PY
		L4	Prototyping techniques	1	SB
M3	Model-based Design and evaluation	L1-L4	Basic idea, introduction to different types of models, GOMS family of models (KLM and CMN-GOMS)	4	SB
		L5, L6	Fitts' law and Hick-Hyman's law	2	SB



NPTEL

<http://nptel.iitm.ac.in>

Computer Science and Engineering

Additional Reading:

- Yvonne Rogers, Helen Sharp, Jennifer Preece; Interaction Design 3rd Edition Wiley 2011
- Frank Bentley, Edward Barrett Building Mobile Experiences MIP Press Cambridge 2012
- Selected research papers (details will be provided at the end of relevant materials).
- Jacob Nielsen; *Useability Engineering*; Morgan Kaufmann, Academic Press, London, 1993.

Coordinators:

Dr.Samit Bhattacharya
Department of Computer Science and Engineering IIT Guwahati

Pradeep P Yammiyavar
Department of Computer Science and Engineering IIT Guwahati

		L7, L8	Model-based design case studies	2	SB
M4	Guidelines in HCI	L1	Shneiderman's eight golden rules	1	PY
		L2	Norman's seven principles	2	PY
		L3	Norman's model of interaction		
		L4	Nielsen's ten heuristics with example of its use	2	PY
		L5	Heuristic evaluation		
		L6	Contextual inquiry	1	PY
		L7	Cognitive walkthrough	1	PY
M5	Empirical research methods in HCI	L1, L2	Introduction (motivation, issues, research question formulation techniques)	2	SB
		L3, L4	Experiment design and data analysis (with explanation of one-way ANOVA)	2	SB
M6	Task modeling and analysis	L1	Hierarchical task analysis (HTA)	1	PY
		L2, L3	Engineering task models and Concur Task Tree (CTT)	2	SB
M7	Dialog Design	L1	Introduction to formalism in dialog design, design using FSM (finite state machines)	1	SB
		L2 – L4	State charts and (classical) Petri Nets in dialog design	3	SB
M8	Cognitive architecture	L1	Introduction to CA, CA types, relevance of CA in IS design	1	SB

		L2, L3	Model Human Processor (MHP)	2	SB
M9	Object Oriented Programming	L1	OOP- Introduction	1	PY
		L2	OOM- Object Oriented Modeling of User Interface Design	1	PY
M10	Design -Case Studies	L1	Case Study 1- Multi-Key press Hindi Text Input Method on a Mobile Phone	3	PY
		L2	Case Study 2 - GUI design for a mobile phone based Matrimonial application.		
		L3	Case Study 3 - Employment Information System for unorganised construction workers on a Mobile Phone.		
Total Modules		10	Total Lectures		40
					SB = 25 PY = 15

References:

- Dix A., Finlay J., Abowd G. D. and Beale R. *Human Computer Interaction*, 3rd edition, Pearson Education, 2005.
- Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T. *Human Computer Interaction*, Addison-Wesley, 1994.
- B. Shneiderman; *Designing the User Interface*, Addison Wesley 2000 (Indian Reprint).



INTERPERSONAL SKILLS

PROF. SMITA JHA

Department of Humanities and Social Sciences
IIT Roorkee

TYPE OF COURSE : New | Core_Elective | PG/UG

COURSE DURATION : 8 weeks (29 Jul'19 - 23 Aug'19)

EXAM DATE : 29 Sep 2019

INTENDED AUDIENCE : Under graduate and post graduate engineering students and post graduate science students

INDUSTRIES APPLICABLE TO : Almost all corporate sector employee will value this course including sales professionals, business leaders and educators. This course is useful for students as well as for housewives.

COURSE OUTLINE :

The proposed course is a program to enhance personality to deal with the various problems of a professional world. Soft skills are becoming increasingly vital to employers as it has become very competitive to survive in a business world. Be it team spirit, communication skills or being a quick-thinker, expressing and demonstrating the right soft skills can make hopeful applicants stand out from the crowd. This course will also focus on pronunciation so as to make one's speech impressive. To excel in a job one surely needs a repertoire of technical skills. This course has been designed to meet all the requirements.

ABOUT INSTRUCTOR :

Prof. Smita Jha is currently working as faculty of English language and literature in the Department of Humanities & Social Sciences, Indian Institute of Technology, Roorkee. She has done M.A. in English (Gold Medalist) from Bihar University, Bihar. She has done Post graduate diploma in teaching English from CIEFL, Hyderabad. Prof. Smita Jha has more than 23 years of teaching experience both at UG and PG level. She has developed course on Neurolinguistics for the first year B.Tech students, She is running Linguistics as elective for the 3rd and the 4th year B.Tech students. She has published more than 50 papers in refereed journals. She has also written books on divers topics like nativization of English prose, partition literature etc. Her research areas are Linguistics, Indian writing in English, World Literature, Contemporary Literary Theory, ELT. She has supervised seven research scholars on various aspects of literature.

COURSE PLAN :

Week 1 : Introduction to Interpersonal skills with pronunciation and communicative skills

Week 2 : Introduction to Body language as part of communicative skills

Week 3 : Introduction to group dynamics and group effectiveness and leadership

Week 4 : Various steps to give a successful oral presentation

Week 5 : Time Management with Negotiation

Week 6 : Creativity and Problem Solving Skills

Week 7 : Stage Freight & Death by PowerPoint

Week 8 : Making Decision & Emotional Intelligence with Group Discussion



INTRODUCTION TO ABSTRACT AND LINEAR ALGEBRA

PROF. SOURAV MUKHOPADHYAY

Department of Mathematics
IIT Kharagpur

INTENDED AUDIENCE : Mathematics

COURSE OUTLINE :

Abstract and Linear Algebra are applicable to every discipline, be it engineering and technology, economics or social sciences. It is essential for the students to get acquainted with the subject of Abstract and Linear Algebra at an early stage. The present course has been designed to introduce the subject to undergraduate/postgraduate students in science and engineering. The course contains a good introduction to each topic and an advance treatment of theory at a fairly understandable level to the students at this stage.

ABOUT INSTRUCTOR :

Prof. Sourav Mukhopadhyay is an Associate Professor at Indian Institute of Technology Kharagpur. He has completed his B.Sc (Honours in Mathematics) in 1997 from University of Calcutta, India. He has done M.Stat (in statistics) and M.Tech (in computer science) from Indian Statistical Institute, India, in 1999 and 2001 respectively. He worked with Cryptology Research Group at Indian Statistical Institute as a PhD student and received his Ph.D. degree in Computer Science from there in 2007. He was a Research Assistant at the Computer Science department of School of Computing, National University of Singapore (NUS). He visited Inria Rocquencourt, project CODES, France and worked as a post-doctoral research fellows at the School of Computer Engineering, Nanyang Technological University (NTU), Singapore. He was a post-doctoral research fellow and a part time Lecturer with School of Electronic Engineering, Dublin City University (DCU), Ireland.

COURSE PLAN :

Week 1 : Basic set theory

Week 2 : Group Theory

Week 3 : Rings and Polynomial rings

Week 4 : Field and finite fields

Week 5 : Matrices and determinants

Week 6 : Vector spaces over fields

Week 7 : Linear transformations and their matrices

Week 8 : Linear equations



INTRODUCTION TO INTERNET OF THINGS

PROF. SUDIP MISRA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : Basic programming knowledge

INTENDED AUDIENCE : CSE, IT, ECE, EE, Instrumentation Engineering, Industrial Engineering

COURSE OUTLINE :

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

ABOUT INSTRUCTOR :

Prof. Sudip Misra is a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles. His current research interests include Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks. Dr. Misra is the author of over 260 scholarly research papers, including 140+ reputed journal papers. He has won seven research paper awards in different conferences. Recently, he and his students won Samsung Innovation Award and the IEEE ComSoc Student Competition. He was awarded the fellow of NASI. He was also awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, Anaheim, California, USA. He was also the recipient of several academic awards and fellowships such as the Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award in the Doctoral level at Carleton University and the National Academy of Sciences, India - Swarna Jayanti Puraskar (Golden Jubilee Award). Dr. Misra was also awarded the Canadian Government's prestigious NSERC Post-Doctoral Fellowship and the Humboldt Research Fellowship in Germany. Dr. Misra has been serving the editorial boards of distinguished journals such as the Transactions on Vehicular Technology, Transactions on Mobile Computing, International Journal of Communication Systems (Wiley) and the IET Wireless Sensor Systems (UK). In the past, he served as the Associate Editor/Editorial Board Member of the Telecommunication Systems Journal (Springer), Security and Communication Networks Journal (Wiley), and the EURASIP Journal of Wireless Communications and Networking, IET Communications Journal, and the Computers and Electrical Engineering Journal (Elsevier). Dr. Misra has published 10 books in the areas of wireless ad hoc networks, wireless sensor networks, wireless mesh networks, communication networks and distributed systems, network reliability and fault tolerance, and information and coding theory, published by reputed publishers such as Cambridge University Press, Springer, Wiley, and World Scientific.

COURSE PLAN :

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud Computing(contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring



INTRODUCTION TO MACHINE LEARNING - IITKGP

PROF. SUDESHNA SARKAR

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : Elective course for UG, PG, BE, ME, MS, M.Sc, PhD

PRE-REQUISITES : Basic programming skills (in Python), algorithm design, basics of probability & statistics

INDUSTRIES APPLICABLE TO : Data science companies and many other industries value machine learning skills.

COURSE OUTLINE :

This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. We will cover the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbour, an introduction to Bayesian learning and the naïve Bayes algorithm, support vector machines and kernels and neural networks with an introduction to Deep Learning. We will also cover the basic clustering algorithms. Feature reduction methods will also be discussed. We will introduce the basics of computational learning theory. In the course we will discuss various issues related to the application of machine learning algorithms. We will discuss hypothesis space, overfitting, bias and variance, tradeoffs between representational power and learnability, evaluation strategies and cross-validation. The course will be accompanied by hands-on problem solving with programming in Python and some tutorial sessions.

ABOUT INSTRUCTOR :

Prof. Sudeshna Sarkar is a Professor and currently the Head of the Department of Computer Science and Engineering at IIT Kharagpur. She completed her B.Tech. in 1989 from IIT Kharagpur, MS from University of California, Berkeley, and PhD from IIT Kharagpur in 1995. She served briefly as faculty at IIT Guwahati and at IIT Kanpur before joining IIT Kharagpur in 1998. Her research interests are in Machine Learning, Natural Language Processing, Data and Text Mining.

COURSE PLAN :

Week 01 : Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

Week 02 : Linear regression, Decision trees, overfitting.

Week 03 : Instance based learning, Feature reduction, Collaborative filtering based recommendation.

Week 04 : Probability and Bayes learning

Week 05 : Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Week 06 : Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

Week 07 : Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

Week 08 : Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.



INTRODUCTION TO R SOFTWARE

PROF. SHALABH

Department of Mathematics
IIT Kanpur

TYPE OF COURSE : Rerun | Core | UG

COURSE DURATION : 8 weeks (26 Jul'21 - 17 Sep'21)

EXAM DATE : 26 Sep 2021

PREREQUISITES : Mathematics background up to class 12 is needed.

Having some preliminary knowledge will be helpful but not necessarily mandatory.

INTENDED AUDIENCE : UG students of Science and Engineering. Students of humanities with basic mathematical background can also do it. Working professionals in analytics and anyone involved in programming, mathematical and statistical computations, simulations and data analysis can also do it.

INDUSTRIES APPLICABLE TO : All industries involved in mathematical and statistical computations, programming and simulations and having R & D set up will use this course.

COURSE OUTLINE

Any scientific task without the knowledge of software is difficult to imagine and complete in the current scenario. R is a free software that is capable of handling mathematical and statistical manipulations. It has its own programming language as well as built in functions to perform any specialized task. We intend to learn the basics of R software in this course.

ABOUT INSTRUCTOR

Prof. Shalabh is a Professor of Statistics at IIT Kanpur. His research areas of interest are linear models, regression analysis and econometrics. He has more than 22 years of experience in teaching and research. He has developed several web based NPTEL courses including on regression analysis and has conducted several workshops on statistics for teachers, researchers and practitioners. He has received several national and international award and fellowships. He has authored more than 70 research papers in national and international journals. He has written four books and one of the book on linear models is coauthored with Prof. C.R. Rao.

COURSE PLAN

Week 1: Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments.

Week 2: Use of R as a calculator, functions and matrix operations, missing data and logical operators.

Week 3: conditional executions and loops, data management with sequences.

Week 4: Data management with repeats, sorting, ordering, and lists.

Week 5: Vector indexing, factors, Data management with strings, display and formatting.

Week 6: Data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames.

Week 7: Data frames, import of external data in various file formats, statistical functions, compilation of data.

Week 8: Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivariate data through graphics, correlations, programming and illustration with examples.



INTRODUCTION TO ROCKET PROPULSION

PROF. D. P. MISHRA

Department of Aerospace Engineering
IIT Kanpur

TYPE OF COURSE : New | Core&Elective | UG/PG

COURSE DURATION : 12 weeks (29 Jul'19 - 18th Oct'19)

EXAM DATE : 16 Nov 2019

PRE-REQUISITES : +2 Science

COURSE OUTLINE :

This is an introductory course on rocket propulsion. The objective of this course is to impart knowledge about rocket propulsion to both UG and PG students. In this course, fundamentals aspects of rocket propulsion namely Solid, Liquid and Hydride rocket engines are to be covered extensively. Besides this, performance of rocket engine and heat transfer aspects of various components are to be covered briefly.

ABOUT INSTRUCTOR :

Prof. Debi Prasad Mishra is a Professor in the Department of Aerospace Engineering at Indian Institute of Technology (IIT) Kanpur, India. His areas of research interest include combustion, computational fluid dynamics, atomization, etc. He was conferred with the Indian Oil Golden Jubilee Professional Chair in IIT Kanpur. He has authored five textbooks and has delivered several lectures on ancient Indian Science and Technology and culture and tradition to more than 45, 000 students across India.

COURSE PLAN :

Week 1: Introduction, Types of Rocket Engines, Applications of Rocket Engines

Week 2: Aerothermodynamics of Rocket Engines, Fundamentals of Aerodynamics, Elements of thermodynamics

Week 3: Combustion, Ideal Rocket Engine

Week 4: Thrust Equation, Rocket Engine parameters, Rocket Engine Nozzles

Week 5: Space Flight Performance, Rocket Propellant

Week 6: Introduction to Solid Propellant Rocket Engine, Components of SPRE, Regression rate relation

Week 7: Liquid Propellant Rocket Engine, Injector, Feed system

Week 8: Hybrid rocket Engine, Rocket Heat transfer

Week 9: Liquid Propellant Rocket Engine, Types of liquid rocket engines, Combustion of liquid propellant

Week 10: Combustion Chamber Geometry, Types of liquid rocket engines, Injectors, Feed system

Week 11: Combustion Instability, Ignition System, Hybrid rocket Engine

Week 12: Rocket Heat transfer, Types of Cooling System



MANUFACTURING AUTOMATION

PROF. SOUNAK KUMAR CHOUDHURY

Department of Mechanical Engineering
IIT Kanpur

PRE-REQUISITES : Basic Engineering Courses

INTENDED AUDIENCE : Mechanical Engineering, Metallurgy, Aerospace Engineering, Production Engineering

INDUSTRIES APPLICABLE TO : All Manufacturing industries, Machine tool manufacturing industries, Automobile Industries and aeronautical assembly industries

COURSE OUTLINE :

The course will basically deal with the following topics: Introduction: Definition; Types of automation; Reasons for automating; Automation strategies. Detroit type automation : Automated flow lines: types and their selection; Methods of workpart transport; Transfer mechanisms; Controlling of automated flow lines. Analysis of automated flow lines: System aspects of designing and running the line; Average production time and production rate; Line efficiency; Analysis of transfer lines without storage – upper bound and lower bound approach; Partial automation. Automated assembly systems: Historical developments of the assembly process; Choice of assembly methods; Design for automated assembly; Transfer systems; Vibratory bowl feeders – its analysis; Non-vibratory feeders and their analysis; Analysis and design of part orienting devices, feed tracks and part placing mechanisms. Orientation of parts in automatic assembly: In-Bowl and Out-of-Bowl Toolings; Typical Orienting Systems: Wiper Blade, Pressure Break, slot in the track; Analysis of Part Orienting Systems; Examples of Out-of-Bowl Toolings; Feed Tracks: Analysis of Horizontal Delivery Feed Track; “ON-OFF” Sensors; Reliability of Feeding.

ABOUT INSTRUCTOR :

Prof. Sounak Kumar Choudhury have completed my Ph.D. in Mechanical Engineering from Moscow, Russia in 1985 followed by post-doctoral at the same university till 1986. From 1986 I am involved in teaching and research in the Mechanical Engineering Department of Indian Institute of Technology Kanpur. My areas of specialization are conventional and non-conventional machining, automatic control, hydraulic control, machine tools and manufacturing automation.

COURSE PLAN :

Week 1 : Definition; Discussion on Pros and Cons of Automation; Benefits of Automation; Types of automation: Fixed automation, programmable automation, and Flexible automation- Typical Features and examples; Reasons for automating; Automation strategies; Automated flow lines: the objectives of the use of flow line automation; General forms of Work Flow – criteria for selection; Methods of work part transport: Continuous, intermittent and asynchronous: types and their selection; Transfer Mechanisms; Examples of transfer mechanisms for linear travel and rotary transfer mechanisms; Buffer Storage;

Week 2 : Flow line Performance Analysis: Average production time and production rate; Mean time per cycle when machine breakdown occurs; Flow line Performance Analysis: Line efficiency; Cost per item produced; Partial automation: Reasons for using, Advantages and drawbacks; Production and Throughput: Examples; Effect of machine Jamming; Component Quality Control; Choice of assembly methods: Cost, Production Rate, Availability of Labour, and Market Life of the Product; Advantages of Automatic Assembly; Design for automated assembly; Components of automatic Assembly Machines;

Week 3 : Transfer systems; Assembly Machines: In-Line, Rotary; Continuous and Intermittent Transfer; Indexing Machines: Factors affecting the choice; Various Indexing Mechanisms; Vibratory bowl feeders: Mechanics of Vibratory Conveying - its analysis; Effect of Frequency, Track Acceleration and Vibration Angle; Effect of Track Angle and Coefficient of Friction; Summary of Bowl Feeder Design; Spiral Elevators; General Requirements of Part Feeders; Non-vibratory feeders : Reciprocating Tube Hopper Feeder – its analysis; General Features. Centerboard Hopper Feeder: Analysis: Maximum Track Inclination, Total Cycle Time, Mean Feed Rate;

Week 4 : Reciprocating Tube Hopper Feeder: Principle of Operation; External Gate Hopper Feeder: Its Analysis: Maximum Peripheral Velocity, Mean Feed rate; Rotary Disk Feeder: Indexing and Rotary Disk Feeder with continuous drive and their analysis: Load sensitivity, Efficiency and Mean Feed Rate; Orientation of Parts in Automatic Assembly: In-Bowl and Out-of-Bowl Tooling's; Typical Orienting Systems: Wiper Blade, Pressure Break, slot in the track; Analysis of Part Orienting Systems; Examples of Out-of-Bowl Toolings; Feed Tracks: Analysis of Horizontal Delivery Feed Track; “ON-OFF” Sensors; Reliability of Feeding.



MANUFACTURING OF COMPOSITES

PROF. J RAMKUMAR

Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun | Core/Elective | UG/PG

COURSE DURATION : 8 weeks (26 Aug'19 - 18 Oct'19)

EXAM DATE : 17 Nov 2019

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE

Selecting manufacturing technique has emerged as one the paramount challenge in the field of composites. Composites are now being used in almost every field of industry, and students working in the area of the composites need to learn the basics, and progressive techniques of composites manufacturing. This course covers the important aspects of composites manufacturing: process selection guidelines, thermoset and thermoplastic Composites manufacturing processes, process parameters and characterizations. Applications and use of each manufacturing process is focused and this is represented separately.

ABOUT INSTRUCTOR

Prof. Janakranjan .Ramkumar is currently a Professor of Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers.

COURSE PLAN

Week 1: Introduction to Composites; Introduction to Composites; Function of the Matrix and Reinforcement in Composites Matrices: Thermosets and Thermoplastic; Fiber Reinforcement

Week 2: Properties and testing composites; Properties of Composites; Composites testing; Composites design: Laminate theory, Rule of mixtures, symmetry and balance

Week 3: Thermoset Composites manufacturing processes; Material selection process cont.; Material selection process cont. Design for manufacturing.

Week 4: Thermoset composite manufacturing processes; Thermoset Composite manufacturing:Lay-up processes,Spray up process; Thermoset Composite manufacturing:Fiber placement process; Thermoset Composite manufacturing:Resin transfer moulding

Week 5: Thermoplastic composite manufacturing processes; Thermoset Composite manufacturing:Vacuum assisted resin transfer moulding; Thermoset Composite manufacturing:Compression molding process; Thermoset composites manufacturing:Filament winding

Week 6: Thermoplastic composite manufacturing processes; Thermoplastic Composite manufacturing:Sheet moulding Thermoplastic Composite manufacturing: Injection moulding, sheet moulding, Calendaring; Thermoplastic Composite manufacturing:Extrusion, Blow molding, rotational molding, Thermoforming

Week 7: Metal and ceramic matrix composites; Metal Matrix Composites:Metal matrix and reinforcement; Manufacturing processes for Metal Matrix Composites:Dispersion hardened and particle composite; Manufacturing processes for Metal matrix composites:Layer composites and infiltration method

Week 8: Prevention of Damage, repair of Composites and selection of processes; Ceramic matrix composites: Hot isostatic processing ; Non – destructive testing of Composites; Manufacturing process selection: Cost, performance, size shape, rate of production. Steps for process selection



MATHEMATICAL MODELING OF MANUFACTURING PROCESSES

PROF. SWARUP BAG

Department of Mechanical Engineering
IIT Guwahati

INTENDED AUDIENCE : Bachelor/Master/PhD students having background in Mechanical/Material Science/Metallurgical engineering/Production Engineering/Manufacturing Technology.

COURSE OUTLINE :

The understanding of the basic mechanism such as heat and mass transport with associated fluid flow including metallurgical transformation, distortion and residual stress generation in different manufacturing processes is the focus of this course. Understanding the complex interaction not only helps to develop mathematical model, it makes the foundation for analysis, numerical simulation at different scale and experimentation for different types of manufacturing processes. The development of computational models for a manufacturing process relies on mathematical expression of the governing mechanism. It helps to design relevant experiments and drives to find the data to be obtained. Mutual understanding between analytical/numerical and experimental results leads to better insight of the basic manufacturing processes that impact on the improvement of existing process and directs for the development of new process. However, this course is completely different from statistical or data driven modeling approach. This course emphasized on the understanding of the most general to advanced manufacturing processes based on scientific principle. The complex mechanism is presented in a simplified way to understand the subject at elementary level. The broad impact is that the students will be able to develop physics based computational model of manufacturing process using standard commercial package (However, this course does not intend to cover the learning of the commercial software).

ABOUT INSTRUCTOR :

Prof. Swarup Bag, The broad area of instructor is teaching and research interest of materials and manufacturing processes through computational models using finite element method and experiments. The instructor completed his Ph.D on "Development of bi-directional heat transfer and fluid flow model for reliable design of GTA and laser welding processes" from Indian Institute of Technology Bombay. Later he has worked at the Center for Material Forming (CEMEF), MINES Paris Tech, France in Metallurgy, Structure and Rheology (MSR) group. Soon after post-doctoral research experience, he joined in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati as a faculty member. His primary area of research is fundamental process modeling of welding and joining technologies, optimization of manufacturing processes and recrystallization in metal forming processes. Dr. Bag has published about 56 journal papers, 45 Conference papers, and 18 book chapters related to welding and joining processes. He is the author of the book 'Computational models for GTA and laser welding processes' and recipient of 'Royal Arc Award 2009' from Indian Institute of Welding for the best PhD thesis in welding. The instructor is involved in teaching the subjects like 'Physics of Manufacturing Processes', 'Engineering Materials', 'Advanced Welding Processes', 'Mechanical Behavior of Materials', 'Solidification Processes' and 'Manufacturing Technology' at IIT Guwahati. The subjects broadly covers the fundamentals of manufacturing processes, mechanical metallurgy, theory of plasticity, heat transfer in manufacturing processes, crystallography, dislocation mechanism, phase transformation and solidification.

COURSE PLAN :

Week 1: Introduction to Manufacturing processes

Week 2: Physics of manufacturing processes

Week 3: Conventional machining

Week 4: Non-conventional machining

Week 5: Metal forming

Week 6: Welding

Week 7: Welding

Week 8: Casting and powder metallurgy

Week 9: Coating and additive manufacturing

Week 10: Heat treatment

Week 11: Micro/nano scale manufacturing

Week 12: Processing of non-metallic materials



PROBLEM SOLVING THROUGH PROGRAMMING IN C

PROF. ANUPAM BASU

Department of Computer Science and Engineering
IIT Kharagpur

INTENDED AUDIENCE : BE/BTech in all disciplines BCA/MCA/M. Sc

INDUSTRIES APPLICABLE TO : All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Use arrays, pointers and structures to formulate algorithms and programs
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration

ABOUT INSTRUCTOR :

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing. Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN :

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching

Week 3: Conditional Branching and Iterative Loops

Week 4: Arranging things : Arrays

Week 5: 2-D arrays, Character Arrays and Strings

Week 6: Basic Algorithms including Numerical Algorithms

Week 7: Functions and Parameter Passing by Value

Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

Week 10: Structures and Pointers

Week 11: Self-Referential Structures and Introduction to Lists

Week 12: Advanced Topics



PRODUCT DESIGN USING VALUE ENGINEERING

PROF.INDERDEEP SINGH

Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE : New | Core_Elective | PG/UG

COURSE DURATION : 4 weeks (29 Jul'19 - 23 Aug'19)

EXAM DATE : 29 Sep 2019

INDUSTRIES APPLICABLE TO : All industries where products are being conceptualized, designed and developed in order to satisfy the human needs and requirements.

COURSE OUTLINE :

It has been established worldwide that the most successful economies are based on innovation and creativity led entrepreneurship. The government is focusing on putting concerted efforts to produce job creators. The current MOOC on Product Design using Value Engineering is conceptualized and planned in such a way that it helps both job creators as well as job seekers. The main objective of the course is to acquaint the learners with the practical knowledge regarding conceptualization, design and development of a new product with a focused Value Engineering Approach. The need of a new product, the product design process, the application of Value Engineering principles in product design process have been discussed in the course. The difference between the concept of Value Engineering and Cost Cutting has been elaborated with examples.

ABOUT INSTRUCTOR :

Dr. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology, Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed eight video and one web course under the National Programme on Technology Enhanced Learning (NPTEL, MOOCs). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

COURSE PLAN :

Week 1: Introduction to product design and development, Product design steps and Product analysis, Profit consideration, Value Engineering (history, concept and definitions), Value Engineering vs. Cost cutting

Week 2: Creative thinking, Problem identification and VEJP, Types of product functions, Functional analysis, Functional Analysis System Technique (FAST)

Week 3: Function-cost relationship I & II, VE applications in product design, Case study I & II

Week 4: VE tools and techniques I & II, Behavioral roadblocks, VE Success stories I & II



PROGRAMMING IN JAVA

PROF. DEBASIS SAMANTA

Department of Computer Science and Engineering
IIT Kharagpur

PRE-REQUISITES : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

INTENDED AUDIENCE : The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

INDUSTRIES APPLICABLE TO : All IT companies.

COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

ABOUT INSTRUCTOR :

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

Week 7: Multithreaded Programming

Week 8: Java Applets and Servlets

Week 9: Java Swing and Abstract Windowing Toolkit (AWT)

Week 10: Networking with Java

Week 11: Java Object Database Connectivity (ODBC)

Week 12: Interface and Packages for Software Development



PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE : Students in any branch of mathematics/science/engineering, 1st year

PRE-REQUISITES : School level mathematics.

INDUSTRIES APPLICABLE TO : This course should be of value to any company requiring programming skills.

COURSE OUTLINE :

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

COURSE PLAN:**Week 1:**

Informal introduction to programming, algorithms and data structures

Downloading and installing Python

gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions

Week 2:

Python: types, expressions, strings, lists, tuples

Python memory model: names, mutable and immutable values

List operations: slices etc

Binary search

Inductive function definitions: numerical and structural induction

Elementary inductive sorting: selection and insertion sort

In-place sorting

Week 3:

Basic algorithmic analysis: input size, asymptotic complexity, $O()$ notation

Arrays vs lists

Merge sort

Quicksort

Stable sorting

Week 4:

Dictionaries

More on Python functions: optional arguments, default values

Passing functions as arguments

Higher order functions on lists: map, iter, list comprehension

Week 5:

Exception handling

Basic input/output

Handling files

String processing

Week 6:

Backtracking: N Queens, recording all solutions

Scope in Python: local, global, nonlocal names

Nested functions

Data structures: stack, queue

Heaps

Week 7:

Abstract datatypes

Classes and objects in Python

"Linked" lists: find, insert, delete

Binary search trees: find, insert, delete

Height-balanced binary search trees

Week 8:

Efficient evaluation of recursive definitions: memoization

Dynamic programming: examples

Other programming languages: C and manual memory management

Other programming paradigms: functional programming



PYTHON FOR DATA SCIENCE

PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering
IIT Madras

PRE-REQUISITES : Knowledge of basic data science algorithms

INTENDED AUDIENCE : Final Year Undergraduates

COURSE OUTLINE :

The course aims at equipping participants to be able to use python programming for solving data science problems

ABOUT INSTRUCTOR :

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

COURSE PLAN :**Week 1:****BASICS OF PYTHON SPYDER (TOOL)**

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

Week 2:**Sequence data types and associated operations**

- Strings
- Lists
- Arrays
- Tuples
- Dictionary
- Sets
- Range

NumPy

- ndArray

Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

Data visualization on Toyota Corolla dataset using matplotlib and seaborn libraries

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

Control structures using Toyota Corolla dataset

1. if-else family
2. for loop
3. for loop with if break
4. while loop
5. Functions

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income

Refrigeration and Air Conditioning - Video course

MODULE 1: Introduction

1st Lecture

Definition of Refrigeration and Air Conditioning

History of Refrigeration and Air conditioning

History from conceptual point of view:

- Ice production by nocturnal cooling in ancient India and application of evaporative cooling in India. Use of natural ice, ice houses and ice trade.
- Vapour Compression Refrigeration Systems
- Vapour Absorption Refrigeration Systems
- Air Cycle Refrigeration Systems
- Miscellaneous Systems (Vapour Jet Refrigeration Systems, Thermoelectric systems, Vortex tube systems, Intermittent-Solar Refrigeration Systems, Combined Cycles)

2nd Lecture

History from Refrigerant development Point of View

- Early refrigerants (SO₂, CO₂, CH₃Cl, CH₄, C₂H₆ etc)
- Introduction of CFCs and HCFCs
- Ozone layer depletion
- HFCs, HCs, NH₃, CO₂, H₂O etc.

History from compressor development point of view

- Low-speed steam engine driven compressors
- High-speed electric motor driven compressors
- Rotary vane compressors
- Centrifugal compressors
- Screw compressors
- Scroll compressors

History of Air Conditioning

MODULE 2: Applications

3rd Lecture

Applications of Refrigeration and Air Conditioning

- a) Comfort Air Conditioning
 - Residential air conditioning
 - Commercial air conditioning
 - Industrial air conditioning
- b) Industrial Refrigeration
 - Chemical and process industries
 - Dairy plants
 - Petroleum refineries
- c) Food processing and food chain
- b) Miscellaneous

MODULE 3: Methods of producing low temperatures

4th Lecture

Applications of Refrigeration and Air Conditioning



NPTEL

<http://nptel.ac.in>

Mechanical Engineering

Coordinators:

Prof. M. Ramgopal

Department of Mechanical Engineering IIT Kharagpur

Prof. R.C. Arora

Department of Mechanical Engineering IIT Kharagpur

- Using enthalpy of mixing (mixing of salt with water)
- Expansion in a turbine
- Throttling
- Thermoelectric effects
- Adiabatic demagnetization

MODULE 4: Review of Fundamentals

5th Lecture

- a) Thermodynamics:
- 1st law of thermodynamics for open and closed systems
 - 2nd law of thermodynamics, Kelvin-Planck and Clausius statements, and Clausius inequality. 3rd law of thermodynamics.
 - Heat Engines, Heat Pumps and Refrigeration Systems, Maximum COP
 - Thermodynamic properties
 - Thermodynamic processes
 - T-s and p-h diagrams

6th Lecture

- a) Fluid Mechanics:
- Continuity and Momentum equations
 - Bernoulli's equation and friction factor
- b) Heat Transfer:
- Modes of heat transfer
 - Concept of thermal resistance and overall heat transfer coefficient
 - Radiative heat transfer coefficient
 - Forced Convection, Free Convection, Boiling and Condensation heat transfer coefficients

MODULE 5: Air Cycle Refrigeration Systems

7th Lecture

- Reverse Carnot Cycle and its limitations
- Bell Coleman, Joule or Reverse Brayton Cycle
- Aircraft refrigeration cycles
- Joule Thompson coefficient and Inversion Temperature
- Linde, Claude and Stirling cycles for liquefaction of air.

MODULE 6: Vapour Compression Refrigeration Systems

8th Lecture

- Comparison of Vapour Compression Cycle and Gas cycle
- Ideal refrigeration cycle – Reversed Carnot cycle and maximum COP
- Deviations of practical cycles from Carnot cycle
- Standard vapour compression refrigeration cycle (SSS cycle), Superheat horn and throttling loss for various refrigerants, efficiency

9th Lecture

- Modifications to standard cycle – liquid-suction heat exchangers
- Grindlay cycle and Lorenz cycle
- Optimum suction condition for optimum COP – Ewing's construction and Gosney's method.
- Actual cycles with pressure drops and heat transfer
- Complete Vapour Compression Refrigeration System

10th Lecture

- Multipressure, multistage systems, optimum intermediate pressure
- Two stage ammonia and halocarbon systems

11th Lecture

- Multi-evaporator systems
- Cascade systems, optimum intermediate temperature
- Manufacture of dry ice and supercritical CO₂ cycle
- Autocascade cycle

MODULE 7: Vapour Absorption Refrigeration Systems

12th Lecture

- Working principle
- Maximum COP of the ideal VARS
- Properties of Mixtures
- Simple absorption refrigeration system

13th Lecture

Lithium bromide-Water Absorption Refrigeration Systems

- Operating principles and applications
- Refrigerant-absorbent properties using tables and charts
- Performance evaluation and methods of improvement
- Practical problems – crystallization and air leakage
- Commercial systems – Single and multistage systems

14th Lecture

Aqua – Ammonia Refrigeration System

- Operating principles and applications
- Refrigerant-absorbent properties using tables and charts
- Practical problems and Principle of Rectification

15th Lecture

Aqua-ammonia Absorption Refrigeration Systems

- Analysis of Generator- Exhausting Column and Rectification column
- Dephlegmator
- Three fluid system
- Solar energy based adsorption refrigeration systems

MODULE 8: Refrigeration system components

16th Lecture

Compressors

Reciprocating Compressors

- Constructional details – open, hermetic and semi-sealed compressors
- Performance of the ideal compressor
- Clearance volumetric efficiency Effects of evaporator and condenser pressures
- Actual volumetric efficiency
- Effects of cylinder cooling, heating and friction
- Empirical equations for actual volumetric efficiency

17th Lecture

Reciprocating Compressors (contd)

- Power requirements of ideal and actual compressors optimum work for given condenser and evaporator pressures, mean effective pressure, pull down characteristics
- Compressor discharge temperatures and need for cooling
- Capacity control

18th Lecture

Centrifugal Compressors

Basic principle of dynamic compressor

- Velocity diagrams
- Efficiency considerations
- Construction details, applications and performance characteristics
- Comparison with reciprocating compressors

19th Lecture

Screw compressors

- Basic principles- single screw and double screw compressors.
- Working principle, work requirement and performance characteristics
- Comparison with reciprocating and centrifugal compressors
- Rotary- single vane and multi-vane compressor

20th Lecture

Condensers

- Classification based on type of construction, flow direction etc.
- Condensing capacity and Heat Rejection Ratio
- Correlations for condensing heat transfer coefficients
- Thermal design of condensers
- Effects of fouling and noncondensable gases on performance

21st Lecture

Evaporators

- Classification based on type of construction, flow direction etc.
- Correlations for boiling heat transfer coefficients for various configurations
- Design and performance aspects
- Effects of pressure drops and frost formation

Use of Wilson's plots

22nd Lecture

Expansion devices

Capillary tubes

- Applications, operating characteristics and selection

Thermostatic expansion valves

- Applications and operating characteristics
- Internal vs external equalizers
- Cross charging, gas charging, liquid charging and fade out point

Automatic expansion valves

Float valves – Low side and high side float valves

Electronic expansion valves

MODULE 9: Refrigerants

23rd Lecture

- Primary and secondary refrigerants
- Designation of Refrigerants.
- Desirable properties of refrigerants including solubility in water and lubricating oil, material compatibility, toxicity, flammability, leak detection, cost, environment and performance issues
- Thermodynamic properties of refrigerants
- Synthetic and natural refrigerants
- Comparison between different refrigerants vis a vis applications
- Special issues and practical implications
- Refrigerant mixtures – zeotropic and azeotropic mixtures

MODULE 10: Properties of moist air (psychrometry)

24th Lecture

- Composition of moist air
- Methods for estimating moist air properties

- Important psychrometric properties
 - o Dry bulb temperature
 - o Humidity ratio
 - o Relative humidity
 - o Degree of saturation
 - o Dew point temperature
 - o Enthalpy

25th Lecture

Psychrometry (contd.)

- o Adiabatic saturation
- o Thermodynamic wet bulb temperature and wet bulb thermometer

Relations between psychrometric properties

Introduction to humidity ratio vs. dry-bulb temperature

psychrometric chart and ASHRAE chart. Use of psychrometric charts and moist air tables, Goff and Gratch tables

MODULE 11: Psychrometric Processes

26th Lecture

- Sensible cooling and heating, RSH
- Humidification and dehumidification, RLH
- Combined heat and mass transfer processes, RTH, RSHF,
 - o Straight line law – coil bypass factor and ADP
 - o Cooling and dehumidification
 - o Heating and humidification
 - o Psychrometric calculations for simple air conditioning system and for return air systems with bypass factor. RSHF, GSHF and ESHF

27th Lecture

Psychrometric processes (contd.)

- o Cooling and humidification (evaporative cooling)
- o Adiabatic mixing
- o Spray washers and cooling towers

MODULE 12: Air conditioning systems for comfort

28th Lecture

- Thermal comfort. Heat transfer from human body by sensible and latent heat transfer. Metabolic heat generation, steady state and unsteady state model for heat transfer, effect of clothing and definition of effective temperatures. PMV and PPD. ASHRAE comfort chart.
- Inside and Outside design conditions
- Summer air conditioning systems
- Winter air conditioning systems
- All year air conditioning systems

MODULE 13: Infiltration and IAQ

29th Lecture

Infiltration

- o Infiltration and ventilation
- o Infiltration due to stack effect, temperature difference and wind velocity
- o Air change and crack length methods for estimating infiltration
- o Infiltration due to door openings

Indoor Air Quality (IAQ)

- o Sources of indoor air pollution
- o Methods of control of IAQ
- o Fresh air requirements for ventilation and IAQ

MODULE 14: Heating and Cooling load calculations

30th Lecture

Heating and Cooling load calculations

- Differences between winter and summer load calculations

- Solar radiation
 - o Distribution of solar radiation
 - o Direct and diffuse solar radiation
 - o Earth sun angles and their relationship

31st Lecture

- Solar radiation (contd.)
 - o Solar radiation on horizontal, vertical and inclined surfaces
 - o Solar radiation through glass, SHGF and shading coefficients
 - o Effects of internal and external shading devices

32nd Lecture

Heat transfer through building structure

- Thermal resistance of various building materials
- Periodic heat transfer through walls and roof
 - o Governing equations
 - o Methods of solution
 - o Decrement factor and Time lag method
 - o Equivalent Temperature difference Method

33rd Lecture

Winter heating load calculations

- Heat losses through the structure
- Heat losses due to infiltration
- Effects of solar radiation and internal heat sources on heating loads
- Degree day and BIN methods for estimating energy requirements for heating

34th Lecture

Summer cooling load calculations

- Heat gain through walls and roof
- Heat gain through glazings
 - o Cooling Load Factors (CLF)
- Heat gain through doors, floor, partition etc.
- Internal heat gains
- Infiltration and ventilation heat gains
- System heat gains (ducts, fans, blowers etc)

35th Lecture

Fixing of supply air conditions for summer air conditioning

- o Supply air temperatures and air quantity, RSHF
- o Outdoor air quantity
- o Bypass factor and coil condition line
- o Cooling load on the room and cooling load on the coil, GSHF
- o High latent heat load applications
- o Use of reheat coils

MODULE 15: Air conditioning Systems

36th Lecture

- All air systems
- All water systems
- Air water systems
- Unitary systems
 - Window air conditioners

MODULE 16: Fan and Duct Systems

37th Lecture

- Frictional pressure drops in straight ducts of circular and rectangular cross-

- section, equivalent diameter for rectangular duct.
- Pressure losses in fittings, due to sudden enlargements, contractions etc.
- Sizing of ducts
 - o Velocity Reduction method
 - o Equal friction method
 - o Static Regain method

38th Lecture

- Selection of fans
 - o Fan laws and fan characteristic curves
- Air distribution in rooms
- Selection and location of supply and return grills, diffusers etc.

MODULE 17: Transport air conditioning Systems

39th Lecture

- Air conditioning systems for automobiles (cars, buses etc.)
- Air conditioning systems for trains
- Air conditioning systems for ships

MODULE 18: Control systems for Refrigeration and Air conditioning applications

40th Lecture

- Closed loop and open loop control systems
- Choice of control systems
- Types of control action
- Energy sources, controllers and controlled devices
- Control based on space temperature
- Control based on outside temperature
- Control based on heating and cooling medium
- Control of humidity
- Complete control systems

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income



SMART MATERIALS AND INTELLIGENT SYSTEM DESIGN

PROF. BISHAKH BHATTACHARYA

Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun | Elective | UG/PG

COURSE DURATION : 4 weeks (21 Feb'22 - 18 Mar'22)

EXAM DATE : 24 Apr 2021

INTENDED AUDIENCE : People aiming to explore advance areas.

PRE-REQUISITES : Basics of Nature and Properties of Materials, Linear algebra

INDUSTRIES APPLICABLE TO : Aerospace, Automobile, Manufacturing industries

COURSE OUTLINE :

Smart Structures and Intelligent System are becoming an integral part of new aerospace and automobile systems due to high performance and fast response potential. Knowledge in this field is multi-disciplinary in nature involving materials, composites, basic electronics, control system and informatics. In this short course, I intend to convey the core flavor of the field by introducing the basic concepts behind such system along with some industrial applications developed in the SMSS laboratory of IIT Kanpur.

ABOUT INSTRUCTOR :

Prof. Bishakh Bhattacharya is currently Dr. Gurumukh D. Mehta and Veena M. Mehta Chair Professor at the Department of Mechanical Engineering and joint faculty at Cognitive Science and Technology, IIT Kanpur. His research interest primarily lies in vibration control, structural health monitoring, energy harvesting system, intelligent system design and Child-Reconfigurable Robot Interaction. He is the coordinator of Space Technology Cell, IIT Kanpur and head of the SMSS (Smart Materials, Structures and Systems) Laboratory.

<http://home.iitk.ac.in/~bishakh/>

COURSE PLAN :

Week 01 : Introduction to Smart Materials

Week 02 : Mechanics of Composite Materials

Week 03 : Induced Strain Actuation Mechanisms

Week 04 : Intelligent System Design



THE JOY OF COMPUTING USING PYTHON

PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering
IIT Ropar

INTENDED AUDIENCE : Any interested audience

PREREQUISITES : 10th standard/high school

INDUSTRY SUPPORT : Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!



WASTEWATER TREATMENT AND RECYCLING

PROF. MANOJ KUMAR TIWARI

Department of Civil Engineering
IIT Kharagpur

INTENDED AUDIENCE : The course will be beneficial for B.Tech/M.Tech/B.Sc/M.Sc/Research Scholars/Faculty members from different institutions. In addition, we will strongly encourage engineers/professionals working in any area related to waste management should consider taking advantage from this unique application orientated course. Regulators (SPCB, CPCB and MOEF professionals) and policy makers will also benefit from this course.

PRE-REQUISITES : Environmental Sciences, Introduction to Environmental Engineering

INDUSTRIES APPLICABLE TO : Larsen and Turbo, Tata Group of Industries, Ramky Group of Industries, IF&LS Environment

COURSE OUTLINE :

This course has emphasises on Integrated Solid Waste Management aspects within the broad subject area of Integrated Waste Management for a Smart City. The issues of Municipal Solid Waste (MSW) management, Construction and Demolition (C&D) Waste and Electronic Waste Management will be covered in this course. The topics will include: generation rates and waste composition; Integrated waste management issues, collection, recovery, reuse, recycling, energy-from-waste, and landfilling; Biological treatment of the organic waste fraction - direct land application, composting, and anaerobic digestion. The environmental impact of waste management and its relationship on the big picture sustainable development and smart city development will be discussed. A major focus of this course will be the role of MSW management within the various initiatives of the Govt. of India including: Swachh Bharat Mission, Smart Cities as well as Make in India. The challenges of waste management for smart cities will also be discussed taking case studies from the first list of 20 smart cities identified in the first phase for this program. This will be followed by overview of the Construction and Demolition (C&D) Waste and Electronic Waste (E-Waste) management issues in India in general and for the smart cities in particular. The new rules with respect of C&D Waste and E-Waste Management will be covered. The challenges of managing these waste streams effectively will be discussed.

ABOUT INSTRUCTOR :

Prof. Manoj Kumar Tiwari [Ph.D. (IIT Kanpur)] is a civil engg. graduate with specialization in environmental engg. and holds expertise in water and wastewater treatment, water distribution systems, water pricing, and contaminant fate and transport. He is a recipient of prestigious Fulbright Fellowship. Prof. Tiwari has co-authored several papers in apex international journals, and has presented his research in various top ranked conferences across the globe. Prof. Tiwari has over 8 years of teaching experience with both UG as well as PG level course. He has designed several new courses at IIT Kharagpur for Masters programme in Water Engineering and Management. He has delivered several invited lectures at various organizations, and has also conducted short-term course under Technical Education Quality Improvement Programme (TEQIP) with participants ranging from Faculties and Ph.D. students from NITs to field professionals working in government organizations as well as private companies.

COURSE PLAN :

Week 1 : Introduction: General outline; Introduction to wastewater; Various sources and types of wastewater; Need of wastewater management; Concept of wastewater treatment and recycling

Week 2 : Wastewater Generation and Characteristics: Wastewater generation and quantity estimation; Water quality parameters and standards (COD, BOD, DO, Solids, Nutrients, metals and emerging contaminants); Sources specific wastewater physical and chemical characteristics

Week 3 : Natural Attenuation of Pollutants in Wastewater: Concept of natural attenuation; Wastewater discharge in rivers; Attenuation of pollutants on land application.



WELDING METALLURGY

PROF. PRADEEP K. JHA

Department of Metallurgy and Material Science
IIT Roorkee

TYPE OF COURSE : Rerun | Core | PG/UG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 24 Apr 2022

PRE-REQUISITES : Introduction to courses such as Welding processes, Materials science etc.

INDUSTRIES APPLICABLE TO : Manufacturing Industries like SAIL, BHEL etc.

COURSE OUTLINE :

The course focuses on understanding the metallurgy and solidification of weldments. The course will make the students aware with the metallurgical aspects of welding. For getting a sound weld, the students are required to be aware of the science behind the welding phenomena, especially in the domain of weld metal solidification, heat transfer, heat treatment processes, strengthening mechanisms etc. The course will be useful for engineering graduates as well as professionals working in the area of welding.

ABOUT INSTRUCTOR :

Prof. Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & Industrial Engineering at IIT Roorkee. He has been teaching the courses related to manufacturing technology and theory of production processes to undergraduate and postgraduate students for more than 12 years. He is actively involved in research work related to production processes, especially casting and welding processes.

COURSE PLAN :

Week 1: Introduction to welding metallurgy, phase diagrams

Week 2: Phase transformation, TTT and CCT diagrams

Week 3: Metal strengthening approaches

Week 4: Heat treatment processes for weldments

Week 5: Analysis of heat flow and temperature distribution in welding

Week 6: Concept of solidification in welding, constitutional supercooling

Week 7: Introduction to heat affected zones, Properties of HAZ

Week 8: Residual stresses in welding, Preheat and postweld heat treatment

Week 9: Types of welding distortion and its control

Week 10: Cracks in welds

Week 11: Weldability issues in materials

Week 12: Welding defects, Design considerations in welding



WELDING OF ADVANCED HIGH STRENGTH STEELS FOR AUTOMOTIVE APPLICATIONS

PROF. MURUGAIYAN AMIRTHALINGAM

Department of Metallurgical and Materials Engineering
IIT Madras

INTENDED AUDIENCE : Final year bachelors and masters students in Metallurgy, Mechanical, Automobile and Production Engineering. Industrial personnel working in automotive and steel making industries.

PRE-REQUISITES : Final year B.E/B.Tech students or Graduates of Metallurgical/Mechanical/Automobile/Production Engineering, Basic knowledge of steel physical metallurgy and welding processes.

INDUSTRIES APPLICABLE TO : All automotive manufacturers and their OEMs and Steel plants.

COURSE OUTLINE :

The use of advanced high strength steels (AHSS) is increasingly preferred in automotive applications due to improved crash energy management and enhanced strength-ductility combinations, resulting in greener and safer vehicles. The weldability of AHSS is generally poorer than conventional steels due to the high alloying contents required to obtain multi-phase microstructure. This course is aimed to discuss the (i) role of alloying elements in stabilizing multi-phase microstructures of AHSS, (ii) effect of weld thermal cycles on the evolution of microstructures and (iii) weldability of AHSS.

ABOUT INSTRUCTOR :

Prof. Murugaiyan Amirthalingam is currently working as an Assistant Professor in IIT-Madras. His research interests include welding metallurgy, welding processes development, steel product development and additive manufacturing

COURSE PLAN :

Week 01 : Introduction to physical metallurgy of advanced high strength steels

Week 02 : Introduction to welding processes in automotive industries (Advanced Gas Metal Arc, Resistance Spot and Laser Welding Processes).

Week 03 : Welding metallurgy of advanced high strength steels – Effect of weld thermal cycles on the stability of phases, solidification behaviour, segregation and hot cracking susceptibility.

Week 04 : Mechanical properties of advanced high strength steel weldments – Tensile shear testing, HAZ softening characteristics, role of modified weld thermal cycles (post pulsing and post weld heat treatments) to improve the mechanical properties.