COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

Department of Mechanical Engineering

Master of Engineering (Advanced Manufacturing Technology)

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2015 - 2016 and onwards)

INDEX

DEPARTMENT OF MECHANICAL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in engineering along with realised social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

MISSION

The Mission is to impart high quality education and training to its students to make them World-class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

DEPARTMENT OF MECHANICAL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF DEPARTMENT OF MECHANICAL ENGINEERING

VISION

The department aims to become one of the top ten mechanical engineering departments in the country within the next decade, in preparing engineers capable of working innovatively and creatively towards a better world.

MISSION

The mission is to :

- Impart sound knowledge through effective teaching-learning methods
- Prepare students to address current and impending challenges facing the country and world at large.
- Create and nurture an environment for fostering innovation and research

DEPARTMENT OF MECHANICAL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

for

M.E. ADVANCED MANUFACTURING TECHNOLOGY

The following Programme Educational Objectives are designed based on the Department Mission **to prepare the students to become graduates**

1. To acquire and demonstrate successfully, capabilities in applied mathematics using scientific principles and fundamental concepts of manufacturing.
2. To carry out research, design, development, testing, analysis, evaluation, and implementation of engineering solutions to problems that are often encountered in professional practice.
3. To be effective innovators, entrepreneurs and collaborators, who can lead or participate effectively to address social, ethical, technical and business challenges.

DEPARTMENT OF MECHANICAL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME OUTCOMES (POs)

FOR

ADVANCED MANUFACTURING TECHNOLOGY

1. Acquire an overall understanding of global perspective which leads to analyse, synthesize and execute various practices by integrating technologies relevant to manufacturing.
2. Enhance creativity and synthesize new methods to analyse complex engineering problems and conduct research in diverse areas pertaining to manufacturing.
3. Ability to design and solve engineering problems to meet the desired needs without compromising on public health and safety while keeping the society and environment intact.
4. Ability to use appropriate research methodologies and tools through wide literature surveys and working towards scientific development.
5. Ability to use state of the art techniques, software resources and tools necessary for effective engineering research activities.
6. Ability to integrate multi-disciplinary areas for technology development by working individually or in teams.
7. An application of engineering and management principles, as a member or as a leader in a team, or as an entrepreneur to effectively manage real-time projects.
8. An ability to communicate effectively by preparing reports and documents to satisfy appropriate standards.
9. Ability to engage in a continuous lifelong learning with enthusiasm and dedication.
10. Realization of ethical and professional responsibilities for overall societal development.
11. Ability to teach effectively the basics and recent developments in manufacturing.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum from the Academic Year 2015 - 2016 onwards

Name of the Degree : M.E. (Full Time)

Specialization : Advanced Manufacturing Technology

Semester I

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA11	Probability and Statistics	4	0	0	4	FC
15MMA12	Optimization for Engineering Applications	4	0	0	4	PC
15MMA13	Advanced Materials Engineering	3	0	0	3	PC
15MMA14	Mechatronics in Manufacturing Systems	3	0	0	3	PC
	Elective - I	3	0	0	3	PE
	Elective - II	3	0	0	3	PE
15MMA17	CIM and Mechatronics Laboratories	0	0	4	2	EEC
	TOTAL CREDITS				**22**	

Semester II

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA21	Advanced Operations Research	4	0	0	4	PC
15MMA22	Design for Manufacture and Assembly	4	0	0	4	PC
15MMA23	Computer Integrated Manufacturing	3	0	0	3	PC
15MMA24	Advanced Metal Joining Technology	3	0	0	3	PC
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
15MMA27	Simulation and Welding Laboratories	0	0	4	2	EEC
	TOTAL CREDITS				**22**	

Semester III

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA31	Rapid Prototyping and Manufacturing	3	0	0	3	PC
15MMA32	Advanced Metal Forming Technology	3	0	0	3	PC
	Elective - V	3	0	0	3	PE
15MMA41	Project Work & Viva Voce	-	-	-	0	EEC
	TOTAL CREDITS				**9**	

Semester IV

Course Code	Course Title	L	T	P	C	Category
15MMA41	Project Work & Viva Voce	-	-	-	18	EEC
	TOTAL CREDITS				**18**	

GRAND TOTAL OF CREDITS : 71

* PC - Professional Core
* FC - Foundation Course
* PE - Professional Elective
* EEC - Employability Enhancement Courses

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum from the Academic Year 2015 - 2016 onwards

Name of the Degree : M.E. (Part Time)

Specialization : Advanced Manufacturing Technology

Semester I

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA11	Probability and Statistics	4	0	0	4	FC
15MMA12	Optimization for Engineering Applications	4	0	0	4	PC
15MMA13	Advanced Materials Engineering	3	0	0	3	PC
15MMA17	CIM and Mechatronics Laboratories	0	0	4	2	EEC
	TOTAL CREDITS				**22**	

Semester II

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA21	Advanced Operations Research	4	0	0	4	PC
15MMA22	Design for Manufacture and Assembly	4	0	0	4	PC
15MMA23	Computer Integrated Manufacturing	3	0	0	3	PC
15MMA27	Simulation and Welding Laboratories	0	0	4	2	EEC
	TOTAL CREDITS				**13**	

Semester III

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA14	Mechatronics in Manufacturing Systems	3	0	0	3	PC
	Elective - I	3	0	0	3	PE
	Elective - II	3	0	0	3	PE
	TOTAL CREDITS				**9**	

Semester IV

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA24	Advanced Metal Joining Technology	3	0	0	3	PC
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
	TOTAL CREDITS				**9**	

Semester V

Course Code	Course Title	L	T	P	C	Category
	THEORY					
15MMA31	Rapid Prototyping and Manufacturing	3	0	0	3	PC
15MMA32	Advanced Metal Forming Technology	3	0	0	3	PC
	Elective - V	3	0	0	3	PE
15MMA41	Project Work & Viva Voce					EEC
	TOTAL CREDITS				**9**	

Semester VI

Course Code	Course Title	L	T	P	C	Category
	PRACTICAL					
15MMA41	Project Work & Viva Voce	-	-	-	18	EEC
	TOTAL CREDIT				**18**	

GRAND TOTAL OF CREDITS : 71

FOUNDATION COURSES (FC)

Course Code	Course Title	L	T	P	C	Category
15MMA11	Probability and statistics	4	0	0	4	FC

PROFESSIONAL CORE (PC)

Course Code	Course Title	L	T	P	C	Category
15MMA12	Optimization for Engineering Applications	4	0	0	4	PC
15MMA13	Advanced Materials Engineering	3	0	0	3	PC
15MMA14	Mechatronics in Manufacturing Systems	3	0	0	3	PC
15MMA21	Advanced Operations Research	4	0	0	4	PC
15MMA22	Design for Manufacture and Assembly	4	0	0	4	PC
15MMA23	Computer Integrated Manufacturing	3	0	0	3	PC
15MMA24	Advanced Metal Joining Technology	3	0	0	3	PC
15MMA31	Rapid Prototyping and Manufacturing	3	0	0	3	PC
15MMA32	Advanced Metal Forming Technology	3	0	0	3	PC

PROFESSIONAL ELECTIVES (PE)

Course Code	Course Title	L	T	P	C	Category
15MMAE01	Design of Advanced Hydraulic and Pneumatic system	3	0	0	3	PE
15MMAE02	Industrial Robotics and Machine Vision	3	0	0	3	PE
15MMAE03	Manufacturing Information systems	3	0	0	3	PE
15MMAE04	Advances in CNC Systems	3	0	0	3	PE
15MMAE05	Flexible Competitive Manufacturing system	3	0	0	3	PE
15MMAE06	Supply Chain Management	3	0	0	3	PE
15MMAE07	Advanced Metrology and Non Destructive testing	3	0	0	3	PE
15MMAE08	Productivity Management and Re-Engineering	3	0	0	3	PE
15MMAE09	Supply chain Information systems	3	0	0	3	PE
15MMAE10	Design of Cellular Manufacturing system	3	0	0	3	PE
15MMAE11	Precision Engineering	3	0	0	3	PE
15MMAE12	Reliability and Total Productive maintenance	3	0	0	3	PE
15MMAE13	Advances in Casting and Welding	3	0	0	3	PE
15MMAE14	Information System Analysis and Design	3	0	0	3	PE
15MMAE15	Computer Aided Process Planning	3	0	0	3	PE
15MMAE16	Corrosion and Surface engineering	3	0	0	3	PE
15MMAE17	Advanced Tool Engineering and Design	3	0	0	3	PE
15MMAE18	Plastics and Composite Materials	3	0	0	3	PE
15MMAE19	Total Quality Systems and Engineering	3	0	0	3	PE
15MMAE20	Advances in Foundry Technology	3	0	0	3	PE
15MMAE21	Finite Element Analysis in Manufacturing Engineering	3	0	0	3	PE
15MMAE22	Advanced Agile and Lean Manufacturing Systems	3	0	0	3	PE
15MMAE23	Advanced Biomaterials	3	0	0	3	PE
15MMAE24	Concepts and Analysis of Robot Manipulators	4	0	0	4	PE
15MMAE25	Smart Materials and Systems	3	0	0	3	PE
15MMAE26	Ultrasonic and Applications	3	0	0	3	PE
15MMAE27	Vibration Analysis and Control	3	0	0	3	PE
15MMAE28	Design of Experiments and Taguchi Methods	3	0	0	3	PE
15MMAE29	Metal Cutting Theory and Practice	3	0	0	3	PE
15MMAE30	Digital Topology	3	0	0	3	PE
15MMAE31	Automotive Suspension and System Dynamics	3	0	0	3	PE
15MMAE32	Cognitive Ergonomics	3	0	0	3	PE
15MMAE33	Optimization Techniques in Manufacturing	3	0	0	3	PE

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Course Code	Course Title	L	T	P	C	Category
15MMAE02	Industrial Robotics and Machine Vision	3	0	0	3	EEC
15MMAE04	Advances in CNC systems	3	0	0	3	EEC
15MMAE08	Productivity Management and Re-Engineering	3	0	0	3	EEC
15MMAE19	Total Quality Systems and Engineering	3	0	0	3	EEC
15MCHE18	Risk Analysis, Assessment and Management	3	0	0	3	EEC
15MMA17	CIM and Mechatronics Laboratories	0	0	4	2	EEC
15MMA27	Simulation and Welding Laboratories	0	0	4	2	EEC
15MMA41	Project Work & Viva Voce	0	0	0	19	EEC

SYLLABI FOR SEMESTER I

15MMA11 - PROBABILTY AND STATISTICS

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *The course is to introduce the advanced statistical skills required for Engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many Engineering fields.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Recoginze basic probability axioms, rules and moments of discreate and continous random Variables.*

CO2 : *Become much more effective in all phases of work relating to research, development, or production.*

CO3 : *Acquire knowledge on discrete time Markov Chains and methods of finding the equilibrium probability distributions.*

PROBABILITY AND RANDOM VARIABLES

Probability and Random variables-Moments-Moment generating function-standard distributions-functions of random variables-Two dimensional random variables-Correlation and Regression. **(14)**

MARKOV CHAIN AND RELIABILITY

Markov chain-Transition Probabilities-Chapman-Kolmogrov equations-Limiting distributions-Concepts of Reliability-Hazard function-Series and Parallel Systems-Reliability and Hazard rate for exponential distribution-Markov analysis-Mean time to failure and mean time between failure-problems (related to them) **(12)**

SAMPLING DISTRIBUTIONS AND TESTING OF HYPOTHESIS

Testing of hypothesis-Sampling distributions-Test based on Normal, t-distribution, chi-square and F-distribution-Analysis of Variance-One way and two way classifications. **(12)**

ANALYSIS OF VARIANCE

Design of experiments-Completely Randomized Design-Randomized Block Design-Latin Square Design-2 Factorial Design. **(12)**

TIME SERIES

Time series-characteristics and Representation-Moving averages -Exponential Smoothing-Auto Regressive processes. **(10)**

TOTAL : 60

REFERENCES

1. *Fruend John, E. and Miller Irwin, "Probability and Statistics for Engineering" 5th Edition. Prentice Hall 2010.*
2. *Jay, L. Devore, "Probability and Statistics for Engineering and Sciences", Brooks/Cole Publishing Company, Monterey California, 2010.*
3. *Montgomery D.C and Johnson, L.A, "Forecasting and Time Series", McGraw-Hill, (2010)*
4. *Gupta, S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics". Sultan Chand and Sons, New Delhi, 2012.*
5. *Trivedi, K.S., "Probability and Statistics with Reliability, Queing and Computer Science Applications, Prentice-Hall, Inc., Englewood Cliffs, New Jercy, 2009.*

15MMA12 - OPTIMIZATION FOR ENGINEERING APPLICATIONS

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To understand the major capabilities and limitations of deterministic operations research modeling as applied to problems in engineering applications.*
- *To recognize, formulate and to use prepared computer programs to solve linear and non- linear constrained/unconstrained problems.*
- *To summarize the reasons why the applicable algorithms work and the effects on the computed solutions of variations in the data or in the assumptions underlying the models.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Mastery of the knowledge, techniques, skills and modern tools used in optimization.*

CO2 : *Apply current knowledge of optimization and adapt to emerging applications in engineering and technology.*

CO3 : *Conduct, analyse and interpret experiments and apply experimental results to improve processes.*

CO4 : *Apply creativity in the design of systems, components or processes appropriate to program objectives.*

INTRODUCTION

Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization - Optimization Techniques - based on nature of contraints. **(10)**

CLASSICAL OPTIMIZATION TECHNIQUES

Single-Variable Optimization - Multivariable Optimization without constraints - Multivariable Optimization with Equality constraints - Method of Lagrange multipliers - Multivariable Optimization with Inequality constraints - Kuhn-Tucker conditions. **(12)**

LINEAR PROGRAMMING

Introduction - Standard form of a linear programming problem - Geometry of linear programming problems - Solution of a system of linear simultaneous equations - Simplex algorithm - Big M method - Two phase methods - Duality in linear programming - Applications of linear programming. **(12)**

NONLINEAR PROGRAMMING

Introduction - Unimodal function - Region elimination methods - Exhaustive search method - Fibonacci method - Golden search method - Gradient search method - Direct root method - Hooke-Jeeves' method - Powell's method - Cauchy's steepest search method. **(12)**

NON TRADITIONAL OPTIMIZATION ALGORITHMS

Non Traditional Optimization - Multi objective optimization - Genetic algorithms and Simulated Annealing - Meta heuristics search techniques - Tabu search and Ant colony optimization - Computer programming for these algorithms. **(14)**

TOTAL : 60

REFERENCES

1. *Singeresu S. Rao, "Engineering Optimization - Theory and Practice", Whiley Publishers, 4th Edition, 2010.*
2. *Kalyanamoy Deb, "Optimization for Engineering Algorithms and Examples", Prentice Hall of India, 2011.*
3. *Goldberg D.E., "Genetic Algorithms in Search, Optimization and Machine Learning", Baren, Addison-Wesley, New York, 2004.*

15MMA13 - ADVANCED MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide details about the behavior of engineering materials and various strengthening procedures.*
- *To gain knowledge about different modes of material fracture and procedure of failure analysis.*
- *To know about properties, processing and applications of both latest metallic and non-metallic materials.*
- *To acquire the essential knowledge about the selection of different latest materials for various applications.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Apply the principles of material selection in engineering manufacture and design and also on effective materials usage.*

CO2 *: Identify service requirements and describe how to relate materials to those requirements.*

CO3 *: Select modern metallic and non-metallic materials for suitable applications.*

INTRODUCTION

Elastic and plastic behavior -Elasticity in metals and polymers -Mechanism of plastic deformation, role of dislocation, yield stress, shear strength of perfect and real crystals -Strengthening mechanism, work hardening, solid solution, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior -super plasticity-Deformation of non- crystalline material. **(9)**

FRACTURE MECHANISM

Fracture behavior -Griffth's theory, stress intensity factor and fracture toughness-Toughening mechanisms -Ductile brittle transition in steel. High temperature fracture, creep-Larsen Miller parameter- Deformation and fracture mechanism maps, Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law-Effect of surface and metallurgical parameters on fatigue- Fracture of non-metallic materials -Failure analysis, source of failure, procedure of failure analysis. **(10)**

MATERIAL SELECTION AND CASE STUDIES

Selection of materials -Motivation for selection, cost basis and service requirement, Selection of material properties, strength, toughness, fatigue and creep. Selection of surface durability corrosion and wear resistance -Relationship between material selection and processing - case studies in material selection with relevance to aero, auto, marine machinery and nuclear application **(9)**

MODERN METALLIC MATERIALS

Modern metallic materials-Dual phase steels, Microalloyed steel, High strength low alloy (HLSA) steel, Transformation induced in plasticity (TRIP) steel, Maraging steel-Inter metallic Ni and Ti aluminides - Smart materials, Shape memory alloys - Metallic glass-Quasi crystal and Nano crystalline materials.**(8)**

NON METALLIC MATERIALS

Non metallic materials -polymeric materials -Formation of polymer structure -production techniques of fibre, foams, adhesives and coatings -structure, properties and application of engineering polymers - advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond -properties, processing and application **(9)**

TOTAL : 45

REFERENCES

1. *Thomas H. Courtney, "Mechanical behavior of materials", 2nd Edition, McGraw-hill, 2000.*
2. *Michael F Ashby, "Materials Selection in Mechanical Design", Butterworth Heinemann, 2005.*
3. *Meyers M A and Chawla K K, "Mechanical Behavior of Materials", Prentice-Hall International Inc, NewJersey, 1999.*
4. *Flinn R.A. and Trojan P.K., "Engineering Materials and their application", 6th Edition, Jaico, 2000*
5. *George E.Dieter, "Mechanical Metallurgy", McGraw Hill, 1988.*
6. *Metals hand book, vol.10 "Failure analysis and prevention", 10th Edition, 1994.*
7. *Kenneth G.Budinski., "Engineering materials: properties and selection", 7th Edition, Prentice Hall of India Limited, New Delhi, 2005.*

15MMA14 - MECHATRONICS IN MANUFACTRING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide basic knowledge about different types of sensors, controllers and actuators used in Mechatronics system.*
- *To gain knowledge in signal conditioning principles.*
- *To gain programming knowledge using microcontroller and PLC in manufacturing systems.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Select suitable sensors, control methods and actuators for developing better manufacturing systems.*

CO2 *: Develop computer programs using microcontroller and PLC.*

CO3 *: Design effective Mechatronics system using advanced signal conditioning aspects*

INTRODUCTION

Mechatronics - key elements - integrated design, Issues in Mechatronics - design procedures for Mechatronics systems - advanced approaches in Mechatronics **(2)**

SENSORS AND TRANSDUCERS

Introduction to sensors and transducers -performance & characteristics of sensors - sensors for motion, position, force, torque, flow, temperature. Selection of sensors. - Problems - Modeling using MatLAB - simulink **(6)**

SIGNAL CONDITIONING

Signal conditioning - analog devices - op amp - inverting, non-inverting, comparator, differentiator, integrator - filtering - low, high and band pass filtering - wheat stone bridge. Quantization theory - DAC - ADC conversion. - problems - Modeling using MatLAB - Simulink **(6)**

ACTUATORS

Mechanical (self-study), Hydraulics / pneumatics - actuating devices - DCVs, flow and pressure control systems - cascading circuits. Electrical - AC & DC motors - stepper motors. Selection of actuators, modeling of electromechanical systems, hydraulic - mechanical systems - problems - Modeling using MatLAB - Simulink **(8)**

SIGNALS, SYSTEMS AND CONTROLS

Modeling dynamic systems - first and second order systems - performance measures. Frequency response - sinusoidal input - root locus - bodo plots - stability - performance specifications. Controls -modes - proportional - derivative - integral - PID - digital controllers. - problems - Matlab - Simulink **(8)**

MICROCONTROLLER

Introduction to microcontroller: Architecture, programming, I/O, Computer interfacing. **(6)**

PROGRAMMABLE LOGIC CONTROLLER

PLC - basic structure - input/output processing, programming- mnemonics, timer, relay and counters, shift registers, master and jump controls data handling, analogue I/O, selection of PLC - Problems **(4)**

APPLICATIONS IN MECHATRONICS

Sensors for condition monitoring, Mechatronics control for automated manufacturing, artificial intelligence in Mechatronics, fuzzy logic application in Mechatronics, micro sensors in Mechatronics - Modeling using MatLAB - Simulink **(5)**

TOTAL : 45

REFERENCE BOOKS

1. *Bolton.W Mechatronics - Electronic Control System in Mechanical and Electrical Engineering - Pearson, New Delhi, 2012.*
2. *Histand Micheal B. and Alciatore David G. Introduction to Mechatronics and Measurement systems - Mc Graw Hill International Ed, Singapore, 2012.*
3. *Isermann Rolf fundamentals, Mechatronic systems - Springle International Edition, New Delhi, 2005.*
4. *Onwubolu Godfrey C Mechatronics principles and applications - Elsevier, India, 2006.*
5. *Shetty Devdas and Kolk Richard, A Mechatronics System Design - Cengage Learning, New Delhi, 2010.*

15MMA17 - CIM AND MECHATRONICS LABORATORIES

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

- *To study the usage of CAD packages, to gain hands on training on various commands used and to familiarize with different analysis & simulation modules.*
- *To develop the programming skill to write programs for component drawing used on a CNC machine.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Design advanced modeling surface related techniques and apply them in an innovative manner.*

CO2 : *Apply various transformations and manipulations in order to simulate and analyze for products functional performance.*

CO3 : *Convert CAD models on computer into a product machined out on a CNC machine in the real time environment using the latest software.*

CIM LAB

Computer Aided Drafting - Operating Systems - Wire Frame, Surface and Solid Modeling - Geomagic freeform modeling - Pro E Study - Helical Gear Solid Modeling using Pro-E - XL Mill CNC Milling [Projection] - Study of Profile Projector - Measurement of Thread Parameter Using Profile projector - Study of Co-ordinate Measuring Machine - XL Turn CNC Lathe [Turning, Facing, drilling and Contouring] -study of feed back milling machine(linear and circular interpoalation)- Manufacturing Simulation Using LEKIN Scheduling Software Package - Mini Project in LEKIN

MECHATRONICS LAB

COURSE OBJECTIVE

- *To study the definition and elements of mechatronics system.*
- *To learn how to acquire and process real time signals by using sensors.*
- *To simulate various mathematical functions and also electronic devices.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Have a firm base of knowledge in areas of mathematics, and physics relevant to mechatronics, and be able to apply and extend this knowledge;*

CO2 : *Integrate mechanical engineering with electronics and intelligent computer control in designing and manufacturing machines, products and processes*

CO3 : *Function effectively on problem-solving teams and to coordinate and provide leadership for teams, including multidisciplinary teams*

FIRST CLYCLE

1. Study of Mechatronics system Design
2. Introduction to Labview.
3. Temperature control system using Labview.
4. Design of vehicle speed indicator using Labview.
5. Measurement of Pressure using Load cell and Labview.
6. Bio signal measurement and Analysis using Labview.

SECOND CYCLE

1. Resistor simulation
2. Capacitor simulation
3. Simple Servo simulation
4. Simple pendulum Simulation
5. Matlab Simulation for performing simple mathematical functions
6. Matlab Simulation of four bar mechanism.

SYLLABI FOR SEMESTER II

15MMA21 - ADVANCED OPERATIONS RESEARCH

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide an in-depth knowledge on different kinds of problems and its optimization procedures.*
- *To provide understanding of capabilities and limitations of deterministic modeling as applied to problems in engineering applications and able to formulate.*
- *To develop computer programs to solve linear and nonlinear constrained / unconstrained problems*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Demonstrate the knowledge, techniques, skills and use of modern tools in optimization.*

CO2 : *Apply this knowledge to emerging applications in engineering and technology.*

CO3 : *Apply creativity in the design of systems, components or processes appropriate to program objectives.*

GEOMETRIC PROGRAMMING

Introduction - Unconstrained Minimization Problem - Solution of an Unconstrained Geometric Programming using Differential Calculus - Solution of an Unconstrained Geometric Programming using Arithmetic Geometric Inequality - Primal-Dual Relationship and Sufficiency Conditions in the Unconstrained Case - Constrained Minimization - Solution of a Constrained Geometric Programming Problem - Primal and Dual Programs in the Case of less-than inequalities - Geometric Programming with Mixed Inequality Constraints - Complementary Geometric Programming - Applications of Geometric Programming. **(12)**

DYNAMIC PROGRAMMING

Introduction - Multistage Decision Processes - Concept of Sub Optimization and Principle of Optimality - Computational Procedure in Dynamic Programming - Example Illustrating the Calculus Method of Solution - Example Illustrating the Tabular Method of Solution - Conversion of a Final Value Problem into an Initial Value Problem - Linear Programming as a Case of Dynamic Programming - Continuous Dynamic Programming - Additional Applications of Dynamic Programming. **(12)**

INTEGER PROGRAMMING

Introduction - Graphical Representation - Gomory's Cutting Plane Method - Bala's Algorithm for Zero-One Programming Problems - Integer Polynomial Programming - Brach-and-Bound Method - Sequential Linear Discrete Programming - Generalized Penalty Function Method. **(12)**

STOCHASTIC PROGRAMMING

Introduction - Basic Concepts of Probability Theory - Stochastic Linear Programming - Stochastic Nonlinear Programming - Stochastic Geometric Programming - Stochastic Dynamic Programming. **(12)**

SELECTED ALGORITHMS

Quadratic Programming - Separable Programming - Multi Objective Optimization - Game Theory - Optimal Control Theory - CPM and PERT. **(12)**

TOTAL : 60

REFERENCES

1. *Hamdy Taha, "Operations Research - An Introduction" 9th Edition, Prentice Hall of India, (P) Ltd., 2012.*
2. *Singeresu S. Rao, "Engineering Optimization - Theory and Practice", 4th Edition, Whiley Publishers, 2010.*
3. *Rao S.S. "Optimization Theory and Applications" Wiley Estem Ltd., New Delhi, 2004.*
4. *Phillips T, Ravindran A, "Operations Research Principles and Practices", 2nd Edition, Whiley Publishers, 2007.*

15MMA22 - DESIGN FOR MANUFACTURE AND ASSEMBLY

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide the basic essential concepts of DFM so that the products to be designed can be manufactured easily.*
- *To enable students to consider all the inherent cost benefits available in the manufacturing process in designing engineering products.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Describe the role of manufacture & assembly within manufacturing industry.*

CO2 : *Evaluate and select manufacturing & assembly processes.*

CO3 : *Apply the cost reduction techniques of forming design, casting design and welding design and solve technical problems.*

DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY

DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka- Yoke principle; Six sigma concept; design creativity. **(9)**

TOLERANCEANALYSIS

Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law. ISO standards - surface finish, review of relationship between attainable tolerance grades and different machining and sheet metal processes. **(13)**

SELECTIVE ASSEMBLY

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples. **(12)**

DATUM SYSTEMS

Degrees of freedom, grouped datum systems-different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pair and tongue-slot pair, computation of translational and rotational accuracy, geometric analysis and applications. **(9)**

TRUE POSITION TOLERANCING THEORY

Comparison between co-ordinate and conventional method of feature location, tolerancing and true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. **(9)**

FORM DESIGN OF CASTINGS AND WELDMENTS

Redesign of castings based on parting line considerations, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features- functional and manufacturing, component design-machining considerations, redesign for manufacture, examples. **(8)**

TOTAL : 60

REFERENCES

1. Harry Peck, `Designing for Manufacture", Pitman Publications, London, 1993.
2. Matousek R, `Engineering Design- A Systematic Approach," Blackie and Son Ltd., London, 2000.
3. *Basem Said El-Haik, "Axiomatic Quality", John Wiley and Sons, 2005.*
4. *Trucks H E, `Design for Economic Production," Society of Manufacturing Engineers, Michigan, Second Edition, 1987.*
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7. *Pahi G and Beitz W, “Engineering Design-Systematic Approach," Springer Verag Pub., 1996.*
8. *Dennis P Hobbs, “Lean Manufacturing Implementation: A Complete Execution Manual for any Size Manufacturing", J Rose Publishing Inc., 2003.*
9. *Mamboed M Farag, “Material Selection for Engineering Design," Prentice Hall, New Jersey, 1997.*

15MMA23 - COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

This course will enable the student

- *To gain knowledge on total manufacturing system at various levels of planning and manufacturing.*
- *To understand the different types of flexible manufacturing systems and to handle the product data and software used for manufacturing*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Acquire a wide knowledge in the field of process planning and other manufacturing management methodologies.*

CO2 : *Apply the different functionalities like LAN, OSA models and different protocols related to Internet and Intranet for manufacturing of engineering components*

INTRODUCTION

Origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - business and financial management **(8)**

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing systems. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - Types of CAPP. **(10)**

SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

Shop floor control-phases -factory data collection system -automatic identification methods-Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- Information flow in Shop floor control systems. **(9)**

CIM IMPLEMENTATION AND DATA COMMUNICATION

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- CIM implementation software. Communication fundamentals- local area networks -topology -LAN implementations - network management and installations. **(10)**

OPEN SYSTEM AND DATABASE FOR CIM

Open systems - open system inter connection -manufacturing automations protocol and technical office protocol (MAP /TOP) Development of databases - Architecture of database systems - data modeling and data associations - relational data bases - database operators - advantages of data base and relational database. **(8)**

TOTAL : 45

REFERENCES

1. *Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Prentice Hall, 2008.*
2. *Yorem koren, "Computer Integrated Manufacturing System", McGraw-Hill, 2007*
3. *Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 2010.*
4. *David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc., 2008.*
5. *Roger Hanman "Computer Intergrated Manufacturing", Addison - Wesley, 1997.*
6. *Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., 2008.*
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15MMA24 - ADVANCED METAL JOINING TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide knowledge about the principle and applications of latest welding processes*
- *To acquire essential significance of thermal effects of welding and subsequent remedial measures to reduce residual stresses and distortion in weldments.*
- *To gain knowledge about the Weldability of different commercially available materials, their corresponding weld joints design and automation of welding processes.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Select suitable welding process and technique to join a given material.*

CO2 *: Identify and minimize the distortion and residual stresses induced in weldments.*

CO3 *: Evolve better weld joint design for both static and fatigue loading conditions.*

SPECIAL WELDING PROCESSES

Electron beam welding, laser beam welding, ultrasonic welding, explosion welding, electro slag and electro gas welding, cold pressure welding, Friction Stir welding, diffusion bonding and adhesive bonding, under water welding - wet & dry, procedure and welder qualification. **(8)**

HEAT EFFECTS OF WELDING

Metallurgical effects of heat flow in welding-TTT curve- continuous cooling transformation diagrams-development of residual stress, methods of relieving or controlling welding residual stresses, types and control of distortion, pre-heat and post welding heat treatment. **(9)**

WELDABILITY OF FERROUS AND NON-FERROUS ALLOYS

Weldability of carbon and alloy steels, stainless steels, cast irons, copper and its alloys, aluminum and its alloys, titanium and its alloys, Ni and its alloys, weldability tests. **(10)**

WELDING DESIGN

Typical joints for different welding processes, principles of welding joint design and location of joint within the member, evolving good weld design, welding symbol- Blue print reading, welding design for static and fatigue loading and problems, fracture toughness. **(9)**

AUTOMATION IN WELDING

Welding sequence and classification of processes, manual and semi-automatic, automatic, automated welding- adaptive controls- remote welding, robotic welding- selecting welding system, gravity welding and fire cracker welding. **(9)**

TOTAL : 45

REFERENCES

1. *Parmar.R.S, "Welding Processes and Technology", 3rd Edition, Khanna Publishers,2013.*
2. *Parmar.R.S, "Welding Engineering and Technology", 2nd Edition, Khanna Publishers, 2013.*
3. *Roa P.N. "Manufacturing Technology", Tata McGraw -Hill, 2005.*
4. *Avitzur , "Metal Forming Processes and Analysis", Tata McGraw - Hill, 2005.*
5. *Dieter, "Mechanical Metallurgy", Tata McGraw - Hill, 2005.*
6. *Harris, J.N., "Mechanical working of Metals - Theory and Practice", Pergamon Press ,1995*
7. *Altan T., "Metal forming - Fundamentals and applications" , American Society of Metals, Metals Park, 2003.*
8. *ASM Hand book, Forming and Forging, Ninth Edition, Vol - 14, 2003.*

15MMA27 - SIMULATION AND WELDING LABORATORIES

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

- *To provide software simulation knowledge for various types of manufacturing systems.*
- *To make use of various software's for simulating and to evaluate and validate the systems built by simulation.*
- *To provide exposure to the students on various welding processes and modeling welding processes*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Simulate and validate any type of manufacturing systems and flexibly use suitable software.*

CO2 *: Select suitable welding technique for the contemporary issues in manufacturing industries.*

CO3 *: Model and optimize welding processes*

SIMULATION LAB

Introduction to simulation languages- Simulation procedure-simulation of manufacturing systems-use of simulation software's - PROMODEL, ARENA, CATIA.

WELDING LAB

1. MIG Welding of MS Plates
2. Pulse TIG Welding of MS plates
3. Demonstation of Stelliting by Plasma Transformed Arc Welding
4. Measurements of Ferrite Content in Austenitic Stainless Steel Weldments
5. Corrosion Studies of welded components
    a. AC Impedence
    b. Cycle sweep
    c. Custom sweep
    d. Rest Potential
    e. Pitting Corrosion
    f. IGC
6. Demonstration of FSW and FS
7. Regression Modelling of GMAW, SAW and FCAW Processes
8. Optimization of welding processes.

SYLLABI FOR SEMESTER III

15MMA31 - RAPID PROTOTYPING AND MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide a detailed knowledge on advanced manufacturing techniques, the Rapid Prototyping and Rapid Manufacturing Process.*
- *To aid in understanding the need, types, application, method of operation and the future of Rapid Prototyping system in industrial application.*
- *To enhance innovative thinking and solve business case studies in RP / RM techniques.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Demonstrate in-depth knowledge about RP/RM technologies along with recent trends in advanced manufacturing.*

CO2 : *Illustrate quick response manufacturing and develope end to end solutions in product manufacture.*

CO3 : *Develop innovative component and product designs using RP/RM technogies.*

INTRODUCTION

Process requirements for Rapid Prototyping - Product Prototyping and Product Development - Prototyping - Need for Prototyping - Issues in Prototyping - Conducting Prototyping - Design Procedure - Prototype Planning and Management - Product and Prototype Cost Estimation - Fundamentals of Cost Concepts - Prototype Cost Estimation - Cost Complexities - Prototype Design Methods - Prototype Design tools - Morphological Analysis - Functional Efficiency Technique - Paper Prototyping - Selecting a Prototype - Learning from Nature. **(7)**

VIRTUAL PROTOTYPING, MATERIALS SELECTION & PROCEDURE FOR PROTOTYPING

Using Commercial Software for Virtual Prototyping - Prototyping Materials - Material Selection Methods - Rapid Prototyping Overview -Rapid Prototyping Cycle - Rapid Prototyping Procedure - STL files - Converting STL File from Various CAD Files - Controlling Part Accuracy in STL Format - Slicing the STL File - Case Studies in Design for Assembly. **(9)**

TYPES OF RAPID PROTOTYPING PROCESS

Types of RP Process - Stereolithography -- Fused Deposition Modelling - Selective Laser Sintering - 3D Printing Process -- Laminated Object Manufacturing - Electron Beam Melting Process -- History - Operation - Advantages and Disadvantages - Applications - Relation to Other RP Technologies - (applies to all the process) - Direct Laser Deposition. **(10)**

APPLICATIONS OF RAPID PROTOTYPING

Investment Casting - Sand Casting - Permanent Mould Casting - Direct RP Tooling - Silicone Rubber Tooling - Investment Cast Tooling - Powder Metallurgy Tooling - Desktop Machining - Case Studies on Current Applications of RP- Novel Application of RP Systems - Future Trends of RP Systems. **(9)**

RAPID MANUFACTURING

Rapid Manufacturing - Potential of RM on Design - Geometrical Freedom - Material Combinations - Customer Input - RM of Prototypes - Reverse Engineering - Interactive CAD Models - Role of Materials in RM - Materials for RM Process - Product Customisation and Case Studies - Future Developments Serving RM - Production Economics of RM - Cost of Manufacture - Application of RM in Medical, Automotive, Aeronautical, Space and Construction Industries. **(10)**

TOTAL : 45

REFERENCES

1. *Cooper, G.K., Rapid Prototyping Technology Selection and Application, Marcel Dekker Inc, USA, 2001.*
2. *Hopkinson, N., Hague, R.J.M, and Dickens, P.M., Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK, 2006.*
3. *Liou, W.F., Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA, 2008.*
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15MMA32 - ADVANCED METAL FORMING TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide the knowledge on the behaviour of engineering material under processing conditions through selection of currently used experimental methods.*
- *To recognize metal forming operations and practices such as forming, rolling, forging, powder metallurgy.*
- *Learning the processes, technology and equipment used in the forming industry.*
- *Understanding the capabilities and limitations of the above manufacturing processes and the guidelines for their selection.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Demonstrate an appropriate mastery of the knowledge, techniques, skills and modern forming processes.*

CO2 : *Apply current knowledge and adapt to emerging applications, engineering and technology.*

CO3 : *Conduct, analyze and interpret experiments and apply experimental results to improve processes.*

CO4 : *Apply the technologies of engineering materials, manufacturing processes, automation, production operations.*

INTRODUCTION

Stress and strain - Three dimensional stress pattern - True stress and true strain - Principal stresses - Yield criteria - Von Mises criterian - Tresca's criterian - Von Mises Yield for plane strain problems - Coloumb function and sticking friction. **(8)**

FORGING

Forging - Forging in plane strain - Forging of circular disc - Effect of friction - Forging equipment - defects in forged products - Causes & Remedies. **(7)**

ROLLING AND EXTRUSION

Rolling and extrusion - Rolling of sheet and strip in plane strain conditions - Effect of friction - maximum draft, rolling load, torque and H.P - roll deflection - defect in rolled products - causes and remedies - forward and backward extrusion - Approximate extrusion loads - tube extrusion. **(10)**

DRAWING

Drawing - Rod and Wire drawing - Equilibrium equation - Strip drawing - tube drawing with mandrel - Effect of friction and cone angle - Defects in drawn parts. **(10)**

UNCONVENTIONAL FORMING METHODS

Unconventional forming - High energy rate forming - Explosive forming - Magnetic Pulse forming - Electro hydraulic forming - Super plasticity - Powder metallurgy - Techniques - Applications. **(10)**

TOTAL : 45

REFERENCES

1. *Mikell P Grover "Principles of Modern Manufacturing (SI Version)" John Wiley & Sons, 2014.*
2. *Roa P.N. "Manufacturing Technology", Tata McGraw -Hill, 4th Edition, 2013.*
3. *Avitzur, "Metal Forming Processes and Analysis", Tata McGraw - Hill, 2005.*
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6. *Taylour Altan, Soo-IK-Oh and Harold L.Gegel, "American Society for Metals",1983.*

SYLLABI FOR ELECTIVE COURSES

15MMAE01 - DESIGN OF ADVANCED HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gain knowledge on various hydraulics and pneumatics systems.*
- *To understand hydraulic and pneumatic circuits used in industries.*
- *To study the various actuators, control systems and its selection methods.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Develop simple and complex hydraulic and pneumatic systems for required applications.*

CO2 *: Select appropriate control systems for particular applications.*

CO3 *: Demonstrate the robotic applications with the help of microprocessors and PLCs.*

INTRODUCTION

Fluid Power - Hydraulic fluids - properties and selection. Pneumatic fluid - properties and selection. Advantages and Applications of Fluid Power. Fluid Power Industry. **(3)**

HYDRAULIC MOTORS AND PUMPS

Oil hydraulic systems-Hydraulic Power Generators-Selection and specification of pumps, pump characteristics. **(5)**

ACTUATORS AND CONTROL UNITS

Hydraulic actuators-Linear and Rotary Actuators- selection, specification and characteristics.

Control and regulation elements-Pressure, direction and flow control valves-relief valves, non return and safety valves-actuation systems. **(10)**

HYDRAULIC CIRCUITS

Hydraulic circuits-Reciprocation, quick return, sequencing, synchronizing circuits- accumulator circuits-industrial circuits- press circuits- hydraulic milling machine- grinding, planning, copying, forklift, earth mover circuits- design and selection of components- safety and emergency mandrels. **(9)**

PNEUMATICS - BASICS AND CIRCUITS

Pneumatic systems and circuits - Pneumatic fundamentals - control elements position and pressure sensing - logic circuits - switching circuits- fringe condition modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method- compound circuit design - combination circuit design. **(9)**

COMBINED CIRCUITS

Installation, maintenance and special circuits - Pneumatic equipments - selection of components - design calculations- application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits. **(9)**

TOTAL : 45

REFERENCES

1. *Antony Espossito, "Fluid power with Applications", Prentice Hall, 7th Edition, 2012.*
2. *Majumdar S R, "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw Hill Publishing Company Limited, 2003.*
3. *Majumdar S R, "Pneumatic Systems : Principles and Maintenance", Tata McGraw Hill Publishing Company Limited, 2003.*
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5. *Andrew Parr, "Hydraulic and pneumatics" ,(HB), Jaico Publishing House, 1999.*
6. *Bolton.W. "Pneumatic and Hydraulic Systems", Butterworth - Heinemann, 1997.*

WEB REFERENCES

1. *www.pneumatics.com*
2. *www.fluidpower.com.tw*

15MMAE02 - INDUSTRIAL ROBOTICS AND MACHINE VISION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide the advanced features of robots, its components and industrial applications of robotics.*
- *To give details about automation and machine vision.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Demonstrate knowledge on automation in robotics application, utilization of robotics in industry and design of robotics system.*

CO2 *: Apply the principles of sensors & their application in robots.*

CO3 *: Demonstrate programming methods & languages of robots.*

ROBOTICS AND ITS COMPONENTS

Robotics - Introduction-Basic Structure- Classification of robot and Robotic systems -laws of robotics - robot motions - work space, precision of movement. Drives and control systems: Hydraulic systems, power supply - servo valve - sump - hydraulic motor - DC servo motors - stepper motors - operation. Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link - Road Systems, Rotary to linear motion conversion, Ract and pinion drives, ball bearing screws, speed reducers, Harmonic drives. **(9)**

KINEMATICS OF ROBOT

Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning. **(9)**

ROBOT END EFFECTORS

Types of end effectors - Mechanical grippers - Types of Gripper mechanisms - Grippers force analysis - Other types of Grippers - Vacuum cups - Magnetic Grippers - Adhesive Grippers-Robot end effector interface.

Sensors: Position sensors - Potentiometers, encoders - LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers. **(9)**

MACHINE VISION

Introduction - Image processing Vs image analysis, image Acquisition, digital Images - Sampling and Quantization -Image definition, levels of Computation. Image processing Techniques: Data reduction - Windowing, digital conversion. Segmentation - Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations. **(9)**

FEATURE EXTRACTION

Geometry of curves - Curve approximation, Texture and texture analysis, Image resolution - Depth and volume, Color processing, Object recognition by features, Depth measurement, specialized lighting techniques. Segmentation using motion - Tracking. Image Data Compression, Real time Image processing, Application of Vision systems. **(9)**

TOTAL : 45

REFERENCES

1. *Davies E R, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Academic Press, 2012.*
2. *John Craig, "Introduction to Robotics, Mechanics and Control", Pearson Education, 2008.*
3. *James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.*
4. *Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall of India, New Delhi, 2001.*
5. *Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI, 2003*
6. *Rafael C. Gonzalez, Richard E. Woods 'Digital Image Processing' Addition- Wesley Publishing Company, 2001.*
7. *M.P. Groover, Industrial Robotics - Technology, Programming and Applications, McGraw-Hill, USA, 2010.*
8. *Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 2010.*
9. *Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1997.*
10. *P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 2001.*

15MMAE03 - MANUFACTURING INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide knowledge on production planning and control system, the databases required to handle records and their maintenance, various methods of collecting data from the shop floor in order to analyze and improve the performance of the manufacturing system.*
- *To realize the importance of information system along with scheduling techniques for customer requirement.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Design the database using various models and approaches.*

CO2 *: Maintain and analyze the database in manufacturing industries.*

CO3 *: Solve the problems of sequencing and scheduling in the real time production shop floor.*

PRODUCTION MANAGEMENT SYSTEM

Introduction - the evolution of order policies from MRP to MRP II, the role of production organization control. **(7)**

DATABASE

Database-Terminologies-Entities & Attributes - Data Models, Schema & Subschema-Data Independence-ER Diagram - Trends in Database **(7)**

DATABASE MANAGEMENT SYSTEMS AND MODELS

Designing database-Hierarchical Model-Network Approach-Relational Data Model-Concepts, Principles, Keys, Relational Operations-Functional Dependence-Normalization, Types - Query Languages. **(10)**

MANUFACTURING SHOP FLOOR CONTROL SYSTEM

Manufacturing Consideration-Product and its structure, Inventory and Process Flow-Shop Floor Control-Data Structure and Procedure-Various Model- Order Scheduling Module, Input/Output Analysis Module, Stock Database- IOM Database. **(11)**

MANUFACTURING INFORMATION SYSTEM

Information system for manufacturing- Parts Oriented Production Information System-Concepts and structure-Computerized Production Scheduling, Online Production Control System, Computer Based Production Management System-Case Study **(10)**

TOTAL : 45

REFERENCES

1. *Luca G. Sartori,"Manufacturing Information Systems", Addision-Wesley Publishing Company, 2003.*
2. *Date.C.J, "An Introduction to Database Systems", Narosa Publishing House, 2004.*
3. *Orlicky.G, "Material Requirements Planning", McGraw-Hill Publishing & Co., 2002.*
4. *Kerr.R, "Knowledge Based Manufacturing Management", Addison Wesley, 2003.*

15MMAE04 - ADVANCES IN CNC SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To learn the elements involved in CNC Machines and Mechanism for converting program of instructions to machine tool action*
- *To generate program using various techniques and study of special type CNC machines*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Demonstrate the principle of CNC and PLC programming techniques, the working of CNC machines and various commands used for 3D model building.*

CO2 *: Write programs and manufacture of products in CNC machines.*

CO3 *: Adapt to the recent techniques in manufacturing.*

INTRODUCTION

Classification - Construction details of CNC machines - machine structure, guideways, feed drives - spindle, measuring systems -Drivers and controls - Spindle drives, feed drives, D.C.drives - A.C.drives **(8)**

CNC SYSTEM

Introduction - Configuration of CNC system -interfacing - Monitoring - Diagnostics- Machine data Compensations for machine accuracies - PLC programming - Adaptive control - CNC systems. **(10)**

PROGRAMMING OF CNC MACHINES

Various programming techniques - APT - Programming for various machines in ISO and FANUC - CAM packages for CNC Machines such as Uni graphics, LDEAS, Pro-Engineer, CATIA, ESPIRIT, MASTERCAM, etc. **(12)**

TOOLING FOR CNC MACHINES

Interchangeable tooling system - present and qualified tools - coolant fed tooling system - Modular fixture - quick change system - Automatic head changers - tooling requirements for turning and machining centres - Tool assemblies - tool magazines -ATC mechanisms - tool management. **(8)**

SPECIAL TYPES OF CNC MACHINES

CNC grinding machines, EDM, Wire cut EDM, CNC Gear Hobbing machine - Installation, Maintenance-Testing and performance, Evaluation of CNC Machines **(7)**

TOTAL : 45

REFERENCES

1. *Michael Mattson, "CNC Programming and Applications", Cengage Learning India Pvt. Ltd., New Delhi, 2014.*
2. *Mehta N K, "Machine tool design and Numerical Control - 3rd Edition", McGraw Hill Co., New Delhi, 2013.*
3. *Radhakrishnan,P "Computer Numerical Control Machines", New Academic Sciences Limited, 2nd Revised Edition, 2014.*
4. *Sehrawat,M.S and NarangJ.S "CNC Mchines", Dhanpat Rai and Co., 2008.*
5. *"Mechatronics", HMT Ltd, TATA McGraw Hill Publishing Company Ltd., 1998.*
6. *Thyer,G.E "Computer Numerical Control of Machine Tools", B.H. Newberg,1991.*
7. *Peter Smid, "CNC Programming Hand Book", Industries Press Inc, 2000.*

15MMAE05 - FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gather the information about Flexible manufacturing system concept in detail.*
- *To understand modern manufacturing methodology*
- *To learn the recent trends in Scheduling and Simulation*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Implement the concepts of group technology, the techniques of part family generation and improve the performance of manufacturing system.*

CO2 *: Apply newer techniques in real time manufacturing environment methodologies in order to reduce total manufacturing lead time and down time in the production shop floor.*

INTRODUCTION

Manufacturing in a competitive environment - Automation of manufacturing process - types of automation - material handling and movement - industrial robots - Sensor technology - flexible, fixturing - Design for assembly, disassembly and services. **(9)**

GROUP TECHNOLOGY AND CELL DESIGN

Group technology - Part families generation - classification and coding - Production flow analysis - Machine cell design - Benefits **(9)**

FLEXIBLE MANUFACTURING SYSTEM AND APPLICATIONS

Flexible Manufacturing System - Introduction - Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Agile manufacturing. **(9)**

SOFTWARE INTEGRATION WITH FMS

Computer software, simulation and database of FMS - System issues - Types of software - specification and selection Trends - Application of simulation software - Manufacturing data system - data flow - CAD/CAM considerations - Planning FMS database. **(9)**

LEAN MANUFACTURING

Just in time - Characteristics of JIT - batch size concepts - work station loads - close supplier ties - flexible work force - line flow strategy. Total productive maintenance - Kanban system - strategic implications - implementation issues - MRD JIT - Lean manufacturing. **(9)**

TOTAL : 45

REFERENCES

1. *Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt Ltd., New Delhi, 2014.*
2. *Jha, N.K."Handbook of Flexible Manufacturing Systems",Academic Press Inc., 1991.*
3. *Kalpakjain, "Manufacturing Engineering and Technology", Addision-Wesley Publishing Co. 2010.*
4 *Talichi Ohno, Toyoto, "Production System Beyond Large-Scale production", Productivity Press (India) Pvt. Ltd.,1992.*

15MMAE06 - SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide a basic and a deeper understanding about supply chain management and the role of supply chain in an industry for meeting end user needs.*
- *To provide a detailed knowledge on product and process management.*
- *To provide an insight of supply chain management from both industrial and end - user perspective.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Recognize the entire process that is undergone by manufacturers in meeting end-user needs.*

CO2 : *Demonstrate from the manufacturer's perspective, students will have innovative ideas to effectively meet the end user needs.*

CO3 : *Solve industrial problems in supply chain management.*

INTRODUCTION

Supply Chain, Objectives & Stages, power of SCM - Process views of a supply chain- Strategic planning, Achieving a strategic fit in a supply chain and factors affecting the strategic fit - Value chain, supply chain flow lines - Product life cycle, Fishers classification of products - Effective and responsive supply chains **(5)**

SUPPLY CHAIN PROCESS

Forecasting in supply chain, characteristics, components, methods and approaches, collaborative forecasting - time series methods of forecasting- forecast error distribution order quantity and reorder point - Demand Management in MPC - MTS - ATO - MTO, customer order lead time - Postponement. Lean - elements of lean, lean techniques, agility, leagility. Mapping business processes using lean. Supply chain process optimization. **(9)**

PRODUCT PROCUREMENT & INVENTORY MANAGEMENT

Procurement process - Sourcing in a supply chain - deciding factors for in-house or outsourcing - 3PL - 4 PL - Supplier selection and assessment - Inventory, economies of scale to exploit fixed costs, Economies of scale to exploit quantity discounts, Managing multi-echelon cycle inventory - Bullwhip effect Safety inventory, Managing safety inventory practice - Product substitution. EOQ - Order Timing Decisions, safety stock, continuous distributions, probability of stocking out criterion, customer service criterion, time period correction factor. General inventory models, dynamic order quantity, deterministic and stochastic inventory models. **(11)**

DESIGNING A SUPPLY CHAIN

Supply chain drivers - Supply chain performance measures - SCOR Model - Network design in a supply chain, factors influencing design, Framework for network design network, models for facility location and capacity allocation - Uncertainty in network design - Discounted cash flow analysis, Decision trees in evaluating network design. Distribution, factors influencing distribution, design options for a distribution network. **(10)**

IT IN SUPPLY CHAIN

Dynamic supply chain design, Impact of technology on SCM, Key trends in SCM, IT in supply chain coordination, IT in supply chain design - MRP, record processing, technical issues, using MRP and system dynamics - ERP - Performance metrics - Functional Silo approach - Integrated supply chain metrics - cash to cash time - CRM - ISCM - Discussion on supply chain adopted by primary industrial sectors and case studies. **(10)**

TOTAL : 45

REFERENCE BOOKS

1. *Ayers, J., Hand Book of Supply Chain Management, CRC Press, 2006.*
2. *Burt, N.D., Dobler, W.D. and Starling, L.S., World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited, 2005.*
3. *Chopra, S., Meindl, P. and Kalra, D.V., Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc., 2008.*
4. *Fredendall, D.L. and Hill, E., Basics of Supply Chain Management, The St Lucie Press / APICS Series on Resource Management, 2001.*
5. *Monczka, R., Trent, R. and Handfield, R., Purchasing and Supply Chain Management, 3rd Edition, Thompson Learning Inc., 2007.*
6. *Taha, H.A., Operations research : An Introduction, Prentice Hall, 2007.*
7. *Vollmann, T.E., Berry, L.W,Whybark,D.C and Jacobs, R.F., Manufacturing Planning and Control for Supply Chain Management, Tata McGraw Hill Publishing Company Limited, 2008.*
8. *Wild, T., Best Practice in Inventory Management, Butterworth - Heinmann, Elsevier Science Ltd., 2002.*

ADDITIONAL READING

1. *European Journal of Innovation Management*
2. *Logistics Information Management an International Journal*
3. Supply Chain Management an International Journal
4. *Sethi, P.S., Yan, H, and Zhang, H (2006), Inventory and Supply Chain Management with Forecast Updates, Springer International Series.*
5. *Mohantry, P.R and Deshmukh, G.S., (2005), Supply Chain Management, Theories and Practices, Published by Biztantra Innovations in Management.*
6. *Kulkarani, S and Sharma, A., (2008), Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*

15MMAE07 - ADVANCED METROLOGY AND NON DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide an insight for the need of quantifying the physical parameters and their techniques in evaluating them.*
- *To provide an insight to principles of latest metrological systems used in industries.*
- *To provide fundamental knowledge on non-destructive testing methods.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Demonstrate techniques used to quantify and comparison of products to required standards.*

CO2 : *Conversant with the newer technologies used in metrology.*

CO3 : *Demonstrate his or her knowledge in developing control mechanism to check variation in attributes and variables.*

INTRODUCTION

Measuring Machines - Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Images shearing microscope- Use of computers- Machine vision technology - Microprocessors in metrology. **(9)**

STATISTICAL QUALITY CONTROL

Statistical Quality Control - Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - reliability and life testing. **(9)**

BASIC NDT TESTS

Liquid penetrants and magnetic particle tests - characteristics of liquid penetrants - different washable systems - Developers - applications - method of production of magnetic fields - Principles of operation of magnetic particle test - applications -Advantages and limitations. **(9)**

RADIOGRAPHY

Radiography - Sources of ray - x- ray production - properties of υ and x rays - film characteristics - exposure charts-contrasts-operational characteristics of x ray equipment - applications. **(9)**

ULTRASONIC TESTING METHODS

Ultrasonic and acoustic emission techniques - Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method -A, B, C scans -Principles of acoustics emission technique - Advantage and limitations - Instrumentation - applications. **(9)**

TOTAL : 45

REFERENCES

1. *Connie Dotson and Roger Harlow, "Fundamentals of Dimensional Metrology", Cambridge University Press, 2006.*
2. *Galyer J F W and Shotbolt C R, " Metrology for Engineers", Thompson Learning Publishers, New York, 2003.*
3. *Jain,R.K."Engineering Metrology ", Khanna Publishers, 2009.*
4. *Barry Hull and Vernon John ," Non Destructive Testing ", Mac Millan, 2009.*
5. *Progress in Acoustics Emission, " Proceedings of 10th International Acoustics Emission Symposium", Japanese Society for NDI,1990.*

WEB REFERENCES

1. *www.metrologytooling.com*
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3. *www.iuk'tu-harburg.de*

15MMAE08 - PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide an understanding of production management and re-engineering concepts, their applications to manufacturing system.*
- *To deal with managerial, strategic and technological dimensions of productivity management and re-engineering.*
- *To understand the improvement tools and techniques, so as to deal with business challenges from a leadership and management perspective globally.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Apply the need for quality assurance, in the industry with engineering standards like ISO 9000-2000*

CO2 : *Use variety of analysis and design techniques to document process improvement and models required for productivity.*

CO3 : *Produce the key deliverable of the product life cycle.*

INTRODUCTION

Introduction - Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle. **(5)**

PRODUCTIVITY MEASURES

Productivity Models - Productivity measurement at International, National and Organizational level, Total Productivity models. Productivity management in manufacturing and service sector. Productivity evaluation models, Productivity improvement models and techniques. **(12)**

ORGANIZATIONAL TRANSFORMATION AND REENGINEERING

Organizational Transformation - Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, DSMCQ and PMP model. **(8)**

PROCESS IMPROVEMENT

Re-engineering - Process Improvement Models, PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model. **(10)**

TOOLS AND TECHNIQUES

Re-engineering Tools and implementation - Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability. **(10)**

TOTAL : 45

REFERENCES

1. *Edosomwan, J.A., "Organisational transformation and process re-engineering", British Library Cataloging in Pub. Data, 2012.*
2. *Sumanth, D.J., "Productivity engineering and management", Tata McGraw Hill, New Delhi, 2010.*
3. *Rastogi, P.N. "Re-engineering and Re-inventing the enterprise", Wheeler Pub. New Delhi, 2006.*
4. *Premvrat, Sardana, G.D. and Shahay, B.S., "Productivity Management - A systems approach", Narosa Pub. New Delhi, 2010.*
5. *Lawrence Leemis., "Reliability : Probabilistic models and Statistical methods", Prentice Hall, 2000.*

15MMAE09 - SUPPLY CHAIN INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide the role played by information system in supply chain enhancement.*
- *To provide a detailed knowledge about e-business and e-commerce application in real World supply chains.*
- *To develop knowledge & role of databases in SCM, along with the knowledge on future projected SC information system.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Demonstrate knowledge in integrated relationship between supply chain and information system*

CO2 *: Identify & analyse the role played by information in initiating the material flow, and the role played by different databases and Internet in processing the supply chain.*

INTRODUCTION

World Wide Web - Web search elements - Web fundamentals - new technologies and innovations - Security protocols - Networks and numbers - Zones and domain names - Packets and protocols - OSI reference model - Intranet and its applications - Types of client server architecture - Extranet Role of IT in network design - forecasting - planning - transportation - sourcing - coordination. **(6)**

E -BUSINESS

e - Business - Evolution of e-business - Types of e-business- Benefits of e-business - Dimensions of e-business and e-com - e-business infrastructure - ERP system - Enterprise structure modeling (Oracle application)- CRM - Selling chain management - infrastructure of selling chain - e-business servers - client connectivity - e-business case studies - e-business relationships with the stake holders - Internal & Internet based requisition development (Access / SQL) **(10)**

E -COMMERCE

The concept of e-commerce - e-commerce activities - Advantages and issues of e-com - Building blocks of electronic commerce - e-commerce business models - Value chain in e-commerce - Electronic auctions - Forward, reverse & Internet Auction - Intermediary Oriented B2B - EDI - Business to Business (B2B)- Kaplan -Sawhney B2B matrix. **(9)**

APPLICATION OF E-COMMERCE

Features and challenges of B2B exchanges - Buyer oriented B2B - Supplier oriented B2B - Business to Consumer (B2C) -Online retailing vs traditional retailing - Product suitability for online retailing - Alternative models of e-retailing: Amazon vs Webvan - elements of successful B2C strategy - Marketing on the internet - Consumer to Business (C2B) - Consumer to Consumer (C2C) - Case studies on e-commerce - m - commerce. **(10)**

ADVANCED SUPPLY CHAIN INFORMATION SYSTEMS

SC information flows - A map of SCM Systems - Drivers of new SC systems & applications - ERP systems - E-sourcing/supply & web based systems- Types of systems - Reverse auctions - Evolving E-sourcing vendors - E-sourcing and fully integrated systems - Information visibility - Benefits of information visibility - e-supply chain fusion - The continuing evolution of E-Supply chains. **(10)**

TOTAL : 45

REFERENCES

1. *Agarwala, N. K., Lal, A. and Agarwala, D., Business on the Net - An Introduction to the 'Whats' and 'Hows' of e-commerce, Macmillan India Ltd., 2000.*
2. *Awad, E.M., Electronic Commerce from Vision to Fulfillment, Prentice Hall India, 3rd Edition, 2007.*
3. *Burt, N.D., Dobler, W.D. and Starling, L.S., World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited, 2005.*
4. *Chakrabarti, R. and Kardile, V., The Asian Managers Handbook of e -commerce, McGraw Hill Publishing Company Limited, 2002.*
5. *Chopra, S., Meindl, P. and Kalra, D.V., Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc., 2008.*
6. *Elsenpeter, C.R and Velte, J.T., E Business: A Beginner's Guide, Tata McGraw Hill Publishing Company Limited., 2001.*
7. *Gerald, B., King, N. and Natchek, D., ORACLE E -Business Suite Manufacturing & Supply Chain Management, Oracle Press, Tata McGraw Hill Publishing Company Limited., 2006.*
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9. *Monczka, R., Trent, R. and Handfield, R., Purchasing and Supply Chain Management, 3rd Edition, Thompson Learning Inc., 2007.*

15MMAE10 - DESIGN OF CELLULAR MANUFACTURING SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

This Course will enable the student

- *To learn various approaches involved in Cellular Manufacturing system.*
- *To understand the design aspects of CMS*
- *To Study about Machine Cell Layout and its performance in detail.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Identify the role of advanced manufacturing technology in improving the productivity, design a cellular manufacturing system and the suitable layout in a manufacturing organization whether big or small*

CO2 : *Optimize various parameters using non-traditional techniques thereby reducing the total production cost.*

INTRODUCTION

Introduction-Introduction of Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT. **(5)**

CELLULAR MANUFACTURING SYSTEM DESIGN AND APPROACH

CMS planning and design - Problems in GT/CMS - Design of CMS - Models, traditional approaches and non-traditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks. **(12)**

MACHINE CELL LAYOUT

Implementation of GT/CMS - Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS. **(10)**

PERFORMANCE MEASUREMENT

Performance Measurement and Control - Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework. **(10)**

COMPARITIVE STUDIES

Economics of GT/CMS - Conventional vs group use of computer models in GT/CMS, Human aspects of GT/CMS -cases. **(8)**

TOTAL : 45

REFERENCES

1. *Burbidge, J.L., "Group Technology in Engineering Industry", Mechanical Engineering Pub. London, 2000.*
2. *Askin, R.G. and Vakharia, A.J., "G.T - Planning and Operation in the automated factory" Hand Book: Technology and Management", Cleland, D.I. AND Bidananda, B(Eds), TAB Books, NY, 1991.*
3. *Irani, S.A,. "Cellular Manufacturing Systems Hand Book", John Wiley & Sons, Inc., 2000.*
4. *Kamrani, A.K. Parsaei, H.R. and Liles, D.H.(Eds), "Planning, design and analysis of cellular manufacturing systems", Elsevier, 1995.*

15MMAE11 - PRECISION ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To understand the concepts of Nano measurement and its applications.*
- *To study about the various machining techniques used in industries and to give first level introduction to micro machining techniques.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Recognize knowledge on latest trends in Nano measurement.*

CO2 *: Apply various precision concepts of modern manufacturing systems for real life application.*

INTRODUCTION

Concepts of accuracy-Introduction- Concepts of accuracy of machine tools -spindle and displacements accuracies -Accuracy of numerical control systems -Errors due to numerical interpolation - displacement measurement system and velocity lags **(9)**

DIMENSIONING AND TOLERANCING

Geometric dimensioning and tolerancing -Tolerance zone conversions -Surfaces, features of size, datum features - datum, oddly configured and curved surfaces as datum features, equalizing datum - datum features of size representation-form controls, orientation controls -logical approach to tolerance **(9)**

NANOTECHNOLOGY - AN INTRODUCTION

Fundamentals of nanotechnology and measuring-Processing system of nanometer accuracies-mechanism of metal processing-nano physical processing of atomic-bit-units nano chemical and electrochemical atomic-bit processing. In processing in-situ measurement position of processing point -post process and on-machine measurement of dimensional feature and surface - Mechanical and optional measuring system. **(9)**

POSITIONING SYSTEMS

Nano-positioning systems of nanometer accuracy and repeatability -Guide systems for moving elements -Servo control systems for tool positioning -Computer aided digital and ultra precision position control **(9)**

MANUFACTURING METHODS

Application and future trends in nano technology -nano-Grating systems -Nano lithography, photolithography, and electron beam lithography -machining of soft materials, diamond turning , mirror grinding of ceramics -development of intelligent products -Nano processing of materials for super high density ICs-Nano-mechanical parts and micro nano machines. **(9)**

TOTAL : 45

REFERENCES

1. *Murthy,R.L.,"Precision Engineering in manufacturing", Tata Mcgraw Hill (P) Limited, 2007.*
2. *James D.Meadows, "Geometric dimensioning and tolerancing", Marcel Dekker Inc., 1995.*
3. *Norio Tanigichi,"Nano Technology", Oxford University Press, 2003.*

15MMAE12 - RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To study the reliability concepts failure data analysis, reliability prediction and management and the concepts of total productive maintenance.*
- *To enable the students to understand the concepts of total productive maintenance and to make them apply these in the industries.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Use of tools for TPM Implementation and able to identify, eliminate losses.*

CO2 *: Measure reliability and relate to safety factors for product testing.*

INTRODUCTION

Introduction - Reliability function - MTBF - MTTF - morality curve -availability - Maintainability. **(05)**

DISTRIBUTIVE FUNCTIONS

Failure Data Analysis - Repair time distributions - exponential, normal, log normal, gamma, and Weibull - reliability data requirements - Graphical evaluation. **(10)**

RELIABILITY PREDICTION

Reliability Prediction - Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis - Standby Systems - Complex Systems. **(10)**

RELIABILITY MANAGEMENT

Reliability Management - Reliability demonstration tests - Reliability growth testing - Duane curve - Risk assessment - FMEA, Fault tree - Reliability Improvement - Analysis of downtime - Repair time distribution - System repair time - Maintainability prediction - Measures of maintainability. **(10)**

TOTAL PRODUCTIVE MAINTENANCE

Total Productive Maintenance - Causes of Machine Failures - Downtime - Maintenance policies - TPM pillars - Autonomous maintenance - Restorability predictions - Replacement models - Spares provisioning - Maintenance management - Cleanliness and House Keeping - TPM implementation. **(10)**

TOTAL : 45

REFERENCES

1. *Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw Hill, New Delhi, 2009.*
2. *Paul Kales, "Reliability for technology, Engineering and Management", Prentice Hall, New Jersey, 2000.*
3. *Modarres, "Reliability and Risk analysis", Meral Dekker Inc., 2005.*
4. *Gopalakrishnan.P, and Banerji A.K., "Maintenance and Spare Parts Management", Prentice Hall of India, New Delhi, 2005.*
5. *Dhillon B.S., "Engineering maintainability: How to design for reliability and easy maintenance", Prentice Hall of India, New Delhi, 2005.*
6. *Ebeling, "An Introduction to reliability and maintainability Engineering", Waveland Pr Limited, 2nd Edition, 2009.*

15MMAE13 - ADVANCES IN CASTING AND WELDING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide knowledge about solidification of metals and corresponding design principles of casting.*
- *To import principles and applications of latest casting processes*
- *To gain knowledge about thermal effects of welding, Weldability of ferrous and non-ferrous metals, residual stresses in weldments, good weld joint design principles and latest welding processes.*
- *To acquire latest knowledge about automation in casting and welding.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Demonstrate the ability to analysis & design economical procedure of product development, incorporating environmental and social issue.*

CO2 : *Acquire skills required to work in a multi-disciplinary environment.*

CO3 : *Recognize knowledge on emerging science of manufacturing principles& engage in lifelong learning process.*

CASTING METALLURGY AND DESIGN

Casting metallurgy and design-Heat transfer between metal and mould-Solidification of pure metals and alloys-Shrinkage in cast metals-Progressive and directional solidification-Principles of gating and riser-Degasification of the melt-Design considerations in casting- Casting defects, Designing for directional solidification and minimum defects. **(9)**

SPECIAL CASTING PROCESS

Special casting process-Shell Moulding, precision investment casting, CO_2, Stir casting, Combo casting, Squeeze casting, Moulding, centrifugal casting, Die casting and continuous casting. **(9)**

WELDING METALLURGY AND DESIGN

Welding metallurgy and design-Heat affected zone and its characteristics-Weldability of steels, Stainless steel, aluminium and Titanium alloys-Hydrogen embitterment-Lamellar tearing-Residual stress-Heat transfer and solidification-Analysis of stresses in welded structures-pre and post welding heat treatments-Weld joint design-Welding defects-testing of weldment. **(9)**

UNCONVENTIONAL AND SPECIAL WELDING PROCESSES

Unconventional and special welding processes-Friction welding- Friction stir welding - Explosive welding-Diffusion bonding-High frequency Induction welding-Ultrasonic welding-Electron beam welding-Laser beam welding. **(9)**

RECENT ADVANCES IN CASTING AND WELDING

Recent advances in casting and welding-Layout of mechanized foundry-sand reclamation-Material handling in foundry-Pollution control in Foundry-Recent trends in casting-Computer Aided design of Castings, Low pressure die casting, Squeeze casting, full mould casting process. Automation in welding-Welding robots-Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding. **(9)**

TOTAL : 45

REFERENCES

1. *Lal.M. and Khanna.O.P."A Text Books of Foundry Technology", Dhanpat Rai & Sons, 2012.*
2. *R S Parmer, "Welding Engineering Technology", Khanna Publishers, 2nd Edition, 2008.*
3. *Jain p L, "Principles of Foundry Technology", Tata McGraw Hill, 2012.*
4. *Titoun.D. & Stepanov.Yu.A.,"Foundry Practice", MIR Publishers,Moscow, 2010.*
5. *Heine Loper& Rosenthal, "Principles of Metal Casting", Tata McGraw Hill, 2010..*
6. *Cornu.J.,"Advanced Welding Systems"-Volumes I,II, and III, JAICO Publishers,1994.*
7. *Lancaster.J.F., "Metallurgy of welding"-George Allen & Unwind Publishers, 1980.*
8. *"Welding Handbook".(Section I) American Welding Society, 1991.*
9. *Kazakov. N.F.,"Diffusion bonding of materials", MIR Publishers, Moscow,1985.*

15MMAE14 - INFORMATION SYSTEMS ANALYSIS AND DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To study the computer based information system, management information systems, system development, quality, Knowledge based system and decision support system.*
- *To enable the students to understand the concepts of information systems focusing on best practices, tools and models to implement an effective management system*
- *To provide knowledge on management skills such as planning, project management, quality and efficiency management in IS projects.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Acquire knowledge and demonstrate of various techniques in computerized information systems in relation to management level decision making.*

CO2 : *Efficiently design and develop of new systems in an organization.*

COMPUTER BASED INFORMATION SYSTEM

Computer Based Information System - Concept of Information and system - system classification - the challenge of information system - computers and information processing - managing data resource - organizing data in a traditional file environment - a modern database environment - designing database **(7)**

MANAGEMENT INFORMATION

Management information system - concepts - Design and implementation of MIS - Information system for decision making, types levels of decision making - MIS as a technique for making a programmed decisions - Decision - Assisting information systems - Conceptual Systems Design - Detailed System design **(10)**

SYSTEM ANALYSIS AND DESIGN

Overview of system Development - System Analysis - System Design-completing the system development process - the traditional system life cycle - stages and limitations of life cycle approach - case study **(10)**

QUALITY

Quality, Success and Services-traditional tool and methodologies for quality assurances- new approaches to quality - information system failure causes- the concept of implementation - controlling risk factor. **(10)**

KNOWLEDGE BASED SYSTEMS

Knowledge - based systems- decision support systems- group DSS- ESS- artificial intelligence- expert system- other intelligent technique -neural network, genetic algorithm, fuzzy logic. **(8)**

TOTAL : 45

REFERENCES

1. *Kenneth C. Laudon and Jane P.Laudon,"Managemant Information systems", Prentice Hall of India Pvt., Ltd.,2010.*
2. *Robert G. Mudrick, Joel E.Ross and James R. Clagget, "Informetion system for modern Management", Prentice Hall of India, 2010.*
3. *Davis . G.B., MIS, "Conceptual Foundation, Structure and Development" Mcgraw Hill Publishing, 2012.*
4. *Chung.P.W.H and Lovegrove G., "Industrial Engineering Application of AI and expert systems", Gardon Breach Science Publication,2010..*

15MMAE15 - COMPUTER AIDED PROCESS PLANNING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To study the Process Planning concepts, Part Design Representation, Process engineering and planning and Computer Aided Process Planning Systems, Integrated Process Planning Systems and part family generation.*
- *To make them apply these in the industries, process planning sheet preparations.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Adopt the process planning procedure after generating part families.*

CO2 *: Make use of certain CAPP related software packages in order to construct operation instruction sheet.*

INTRODUCTION

Introduction - The Role of Process Planning in the manufacturing cycle - Process Planning and Production Planning - Process Planning and Concurrent Engineering, CAPP, Group Technology **(5)**

GROUP TECHNOLOGY

Part Design Representation - Design Drafting - Dimensioning - Conventional tolerancing - Geometric tolerancing - CAD - input/output devices - topology - Geometric transformation - Perspective transformation - Data Structure - Geometric modeling for process planning - GT coding - The OPITZ system - The MICLASS system- CODE system. **(10)**

PROCESS PLANNING

Process engineering and process planning - Experience based planning - Process capability analysis - Process Planning - Forward and Backward planning & scheduling, software for studying, Input format, AI. **(10)**

COMPUTER AIDED PROCESS PLANNING

Computer Aided Process Planning Systems - Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP. - Process planning Softwares. **(10)**

PROCESS PLAN SYSTEMS

An Integrated Process Planning Systems - Totally integrated process plans systems - An overview - Modulus structure - Data Structure, operation - Report generation, Expert Process Planning. **(10)**

TOTAL : 45

REFERENCES

1. *Gideon Halevi and Roland D.Weill,"Principles of Process planning, A logical approach", Chapman Hall, 1995.*
2. *Tien - Chien Chang, Richard A.Wysk,"An introduction to automated process planning systems", Prentice Hall,1985.*
3. *Chang, T.C.,"An Expert process planning system", Prentice Hall, 1985.*
4. *Nanua singh, "Systems approach to Computer Integrated Design and Manufacturing", John Wiley & Sons,1996.*
5. *P.N. Rao, "Computer Aided Manufacturing",Tata McGraw Hill Publising CO., 2000.*

WEB REFERENCE

1. *http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm*
2. *http://Estraj.ute.sk/journal/engl/027/027.htm*

15MMAE16 - CORROSION AND SURFACE ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide detailed knowledge about different types of corrosion mechanism, corrosion behavior of ferrous and non-ferrous materials and the factors that influence it.*
- *To gain knowledge about the standard corrosion testing procedure and corrosion prevention methods.*
- *To acquire properties and applications of various surface coating techniques*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Identify the possible type of corrosion that the selected material could be subjected to and the corresponding corrosion prevention measures to be adopted.*

CO2 : *Knowing the corrosion and wear behavior of materials one could select suitable surface coating methods and effectively control the properties of coatings.*

INTRODUCTION

Mechanisms and types of corrosion - Principles of direct and Electro chemical corrosion, Hydrogen evolution and oxygen absorption mechanisms - Galvanic corrosion, Galvanic series - specific types of corrosion such as, Uniform, Pitting, Inter granular, Cavitations, Crevice, Fretting, Erosion and Stress corrosion - Factors influencing Corrosion. **(10)**

TESTING METHODS

Testing and prevention of corrosion - Corrosion testing techniques and procedures - Prevention of corrosion - Design against corrosion - Modification of corrosive environment - Inhibitors - Cathodic protection - Protective surface coatings **(8)**

CORROSION OF MATERIALS

Corrosion Behavior of Materials - Corrosion of Steels, Stainless steels, Aluminium alloys, Copper alloys, Nickel alloys and Titanium alloys - Corrosion of polymers, Ceramics and composite materials **(8)**

SURFACE ENGINEERING

Surface engineering for wear and corrosion resistance - Diffusion coatings - Electro and Electroless plating - Hot dip coating - Hard facing - Metal spraying, Flame and Arc processes - Conversion coatings - Selection of coating for wear and corrosion resistance **(10)**

THIN LAYER ENGINEERING PROCESSES

Thin Layer Engineering Processes - Laser and Electron Beam hardening - Effect of process variables such as power and scan speed - Physical vapour deposition, thermal evaporation, Arc vapourisation, Sputtering, ion plating - Chemical vapour deposition - Coating of tools, TiC, TiN, Al_2O_3 and Diamond Coating properties and applications of thin coatings. **(9)**

TOTAL : 45

REFERENCES

1. *Fontana, G., "Corrosion Engineering", McGraw-Hill, 2010.*
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3. *Winston Revie, R,Uhlig's "Corrosion, Hand Book", 2nd Edition, JohnWiley, 2000.*
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5. *"Metals Handbook, Vol.5- Surface Engineering", ASM International, 1996.*

15MMAE17 - ADVANCED TOOL ENGINEERING AND DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To enable the students to understand the analysis, planning, design, construction and application of tools, methods and procedures necessary to increase manufacturing productivity.*
- *To provide an exposure to the recent trends in the field of tool engineering.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Work on tool design related software's and its applications.*

CO2 *: Design of the metal cutting tools.*

CO3 *: Select proper tools for appropriate applications considering type of process.*

MECHANISM OF CHIP FORMATION AND TYPES OF CHIPS

Mechanism of chip formation, Types of chip, techniques for the study of chip form formation, chip tool interface, built- up edge, chip breakers etc - problems. **(4)**

FORCES IN METAL CUTTING

Stress on the shear plane, Shear angle relationship in thin plane analysis. Minimum energy theory - stresses on the tool. Measurement of tool Forces - virtual tool dynamometers - evaluation of cutting forces, tool failures, work piece failure etc. with various real time problems **(5)**

THERMAL ASPECTS OF METAL CUTTING

Heat in metal cutting, Flow of heat, Methods of tool temperature measurement, significance of cutting tool temperature. Cutting fluids - Types and selection - evaluation of heat flow in both the tool and work piece. **(4)**

CUTTING TOOL MATERIAL AND TOOL WEAR

Cutting tool materials - classification, application, heat treatment. Mechanisms of tool wear, Tool failure, Methods of tool wear Measurement. Tool life, Machinability index, Tool life equations, Universal machinability index, Economics of turning. **(9)**

THERMAL ANALYSIS WITH CFD SOFTWARE

Introduction to CFD - various tools and techniques in CFD - various features of CFD - Applications of CFD - Comparisons of CFD with ANSYS and NISA - CFD in thermal analysis of metal cutting. **(5)**

JIGS & FIXTURES

Fundamental ideas and principles of Jigs and Fixtures. Design of drill jigs and fixtures for turning, drilling, milling, broaching and grinding operations. Locating and clamping devices of jigs and fixtures. Indexing devices and types. Different types of jigs & fixtures. Design of a jig and fixtures for the given component by using Computer Aided Design (CAD). **(9)**

PRESS TOOLS & ECONOMIC ASPECTS OF TOOLING

Dies, punches, types of presses, clearances, types of dies, strip layout, calculation of press capacity, center of pressure. Design consideration for die elements. Economics of tooling - Tool selection and tool replacement with respect to small tools. **(9)**

TOTAL : 45

REFERENCES

1. *Ranganath B J, "Metal Cutting and Tool Design", Vikas Publishing House, 2001.*
2. *Ranganath.B J, "Tool Engineering Design:, Vikas Publishing House Pvt. Ltd, New Delhi, 2nd Edition, 2012.*
3. *ASTME "Fundamentals of Tool design:.Prentice Hall of India Pvt. Ltd., New Delhi. 5th Edition, 2000.*
4. *Sharma. P.C.,"A Text Book of Production Engineerig" S.Chand & Co. Ltd., New Delhi, 2005*
5. *"P.S.G Design Data Book", PSG college of Technology, DPV printers, Coimbatore, 2005.*

15MMAE18 - PLASTICS AND COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To import knowledge about different types of plastics and composites and their fabrication methods.*
- *To acquire details about the effects of machining and joining parameters on its quality*
- *To gain knowledge about the different types of reinforcements and its corresponding fabrication methods of composites.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Select suitable plastics and composite materials for the required applications and its corresponding fabrication method.*

CO2 : *Identify service requirements and how to relate materials to those requirements.*

CO3 : *Identify the various properties of composites and plastics.*

INTRODUCTION

Introduction - Chemistry and classification of Polymers - Properties of Thermo plastics and Thermosetting plastics - Applications - Merits and Demerits. **(5)**

PLASTICS PROCESS

Processing of plastics - Extrusion - Injection Moulding -Blow Moulding - Compression and transfer Moulding - casting - Thermo Forming. Machining and joining of plastics - General Machining Properties of Plastics - Machining Parameters and their effect - joining of Plastics- Mechanical Fasteners - Thermal bonding - Press Fitting. **(17)**

COMPOSITE MATERIALS

Introduction to Composite Materials - Fibers - Glass, Boron , Carbon , Organic , Ceramic and Metallic Fibers - Matrix Materials - Polymers, Metals and Ceramics. **(5)**

POLYMER MATRIX COMPOSITES

Processing of Polymer Matrix Composites - Open Mould Processes, Bag Moulding, Compression Moulding With BMS and SMS - Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding - Application of PMC`s **(9)**

METAL MATRIX COMPOSITES

Processing of metal matrix composites - Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques - Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fiber - Liquid State Fabrication Method - Infiltration - Squeeze Casting - Rheo Casting - Compocasting - Application of MMC`s. **(9)**

TOTAL : 45

REFERENCES

1. *Harold Belofsky, "Plastics: Product Design and Process Engineering", Hanser Publishers, 1995.*
2. *Bera, E and Moet, A, "High Performance Polymers", Hanser Publisners ,1991*
3. *Hensen.F, "Plastics Extrusion Technology", Hanser Publishers, 1988.*
4. *Johnnaber F, "Injection Moulding Machines", Hanser Publishesr, 1983.*
5. *Rauwendaal, C, "Polymer Extrusion", Hanser Publishers, 1990.*
6. *.A.K.B hargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice-Hall of India Limited, New Delhi, 2005.*

15MMAE19 - TOTAL QUALITY SYSTEMS AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *This course aims at providing the concepts of TQM, SQC and Acceptance sampling.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Design a better system in manufacturing and implement the appropriate processes.*

CO2 *: Apply the basic concepts of sampling problems in real world applications.*

CO3 *: Demonstrate his ability in solving industrial problems using SQC methods.*

PRINCIPLES OF TQM

Introduction - Principles of Quality Management - Pioneers of TQM - Quality costs - Quality system Customer Orientation - Benchmarking - Re-engineering - concurrent engineering. **(9)**

LEADERSHIP AND QUALITY AUDITING

Practices of TQM - leadership - organizational structure - Team building - Information systems and documentation - Quality Auditing - ISO 9000 - QS 9000. **(9)**

TQM TECHNIQUES

Techniques of TQM - Single vendor concept - JIT- Quality Function Deployment - Quality circles - KAIZEN - SGA - POKA - YOKE - Taguchi Methods. **(9)**

STATISTICAL QUALITY CONTROL

Statistical Quality control - Methods and Philosophy of Statistical process control - Control Charts for variables and Attributes - Cumulative sum and exponentially weighted moving average control charts - Other SPC Techniques - Process Capability Analysis - Six Sigma accuracy. **(9)**

SAMPLING

Acceptance sampling - Acceptance sampling problem - Single sampling Plans for attributes - double, multiple and sequential sampling, Military standards - The Dodge & Romig sampling plans. **(9)**

TOTAL : 45

REFERENCES

1. *Suresh Dalela and Saurabh, "ISO 9000 - A Manual for total Quality Management", S.Chand and Company Ltd., 1997*
2. *John Bank, "The Essence of Total Quality Management", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2001.*

3. *Dale H. Besterfield, Carol Besterfield-Michna and Glen H. Besterfield, "Total Quality Management", Pearson Education Private Ltd., 2007.*
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9. *Douglus C Montgomery, "Introduction to Statistical Quality Control", McGraw Hill, 2009.*
10. *Grant E.L and Leavensworth, "Statistical Quality control", McGraw Hill, 2000.*

WEB REFERENCES

1. *www.ahepr.gov/research/feboo/0200ra15.htm.*
2. *www.mcb.co.uk/tam.htm*

15MMAE20 - ADVANCES IN FOUNDRY TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To know about the casting metallurgy and design aspects of moulding, gating and riser.*
- *To learn about the special casting processes and foundry mechanization.*
- *To understand about the computer applications in foundry technology.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Perform casting design with the acquired knowledge on runner, riser, gates materials and components for the desired product.*

CO2 : *Apply computer aided design for the casting and select suitable foundry technique for the desired product.*

CO3 : *Design a better foundry layout in order to increase the productivity by implementing mechanization techniques and computers.*

INTRODUCTION

Basics of casting techniques - Various aspects of advances inn foundry technology - Scope of the study **(1)**

CASTING METALLURGY AND DESIGN

Casting metallurgy & design - Solidification of pure metals and alloys - Fluidity- Shrinkage in cast metals - Absorption of gases - Degassing methods - Progressive solidification - Directional solidification - Hot spot & Junction - Design for moulding-Design for core support. **(9)**

PRINCIPLE OF GATING AND RISER

Principle of gating and riser - Improvement of yield efficiency - Simple problems in gating and risening for steels and cast irons **(9)**

SPECIAL CASTING PROCESSES

Special casting processes - Shell moulding, investment casting, Carbon - Dioxide moulding, Centrifugal casting, Die casting, Continous casting, Squeeze casting, Vaccum casting, Full mould processes, Semi-Solid metal casting,Thixocasting and Rheocasting process, Compo casting. **(11)**

FOUNDRY MECHANIZATION

Foundry mechanization - Layout of mechanized foundry - Sand reclamation - Material handling in foundry - Pollution control in foundry - Casting defects - Identification, Analysis and Remedies. **(9)**

COMPUTER AIDED DESIGN AND CASTINGS

Computer aided design and castings - Computer aided pattern making and use of rapid prototyping technology in foundry, Feeder design and solidification analysis, Gating design and mould filling analysis, Rapid tooling fabrication, Implementing rapid casting development technologies, Case study from industry. **(6)**

TOTAL : 45

REFERENCES

1. *Heine R W., Loper, C.R.Rosenthal, P.C.,"Principles of Metal Casting",Tata-McGraw Hill Publishing Co Ltd, 2010*
2. *Jain P.L,"Principles of Foundry Technology", Tata McGraw Hill Publishing Co Ltd, New Delhi, 2010*
3. *R.K. Jain "Principles of Foundry Technology", 3rd Edition, Tata Mc Graw Hill, 2005.*
4. *"ASM Metals Hand book on Casting", Revised Edition 1995.*
5. *Heine.R.W.Loper and Rosenthal "Principles of Metal Casting" Tata Mc Graw Hill, 1997.*
6. *Peter Beelay "Foundry Technology", Second Edition, Butterworth, 2001.*
7. *Ravi.B "Metal Casting Computer aided Design and Analysis" Prentice Hall, 2005.*
8. *Srinivasan. N.K. "Foundry Engineering" Khanna Tech Pub Co, New Delhi, 2000.*

15MMAE21 - FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gain fundamental knowledge and techniques of FEM for solving boundary value problems and manufacturing process.*
- *To gain exposure to commercial FE analysis packages.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Solve boundary value problems using classical as well as finite element methods.*

CO2 *: Demonstrate his/her ability in selection of appropriate elements.*

CO3 *: Solve simple practical problems using commercial FE analysis packages.*

INTRODUCTION

Introduction -Basic of FEM - Initial value and boundary value problems - weighted residual Galerkin and Raleigh -Ritz methods - Review of variational formulation. **(6)**

1D ANALYSIS

One dimensional analysis - Steps in FEA - Discretization, interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing-one dimensional analysis in solid mechanics and heat transfer. **(10)**

2D ANALYSIS

Shape functions and higher order formulations - Global and Natural co-ordinates - Shape functions for one and two dimensional elements- three noded triangular and four noded quadrilateral element - non-linear analysis - Isoparametric elements - Jacobian matrices and transformations - basic of two dimensional axi-symmetric analysis. **(10)**

ANALYSIS OF PRODUCTION PROCESSES

Analysis of production processes-FEA of metal casting-Special considerations, latent heat incorporation, gap element-Time stepping procedures-Crank-Nicholson algorithm-Prediction of grain structure. Basic concepts of plasticity-Solid and flow formulation-Small incremental deformation formulation-FEA of metal cutting, chip seperation criteria, incorporation of strain rate dependency. **(10)**

COMPUTER IMPLEMENTATION IN FEA

Computer implementation-Preprocessing, Mesh-generation, element connecting, boundary conditions, input of material and processing characteristics-Solution and post processing-Overview of application packages such as ANSYS and Abaqus FEA. Development of code for one dimensional analysis and validation. **(9)**

TOTAL : 45

REFERENCES

1. *Reddy, J.N. "An Introduction to Finite Element Method", McGraw-Hill, 2012.*
2. *Rao, S.S, "Finite Element Method in Engineering", Elsevier, 2012.*
3. *Bathe. K. J., "Finite Element Procedures", Cambridge, MA: Klaus-Jürgen Bathe, 2012.*
4. *SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T, "Metal forming and Finite Element Method" Oxford University Press, 1989.*
5. *Lewis R.W., Morgan K. Thomas, H.R. and Seetharaman K.N., "The Fintie Element Method in Heat Transfer A nalysis", John Wiley, 1996.*
6. *Edward R Champion, "Finite Element Analysis in Manufacturing Engineering", Oxford and IBH Publishing, New Delhi, 1989.*
7. *Lars-Erik Lindgren., "Computational Weld Mechanics - Thermomechanical and microstructural simulations", Woodhead Publishing Ltd., Cambridge England, 2007.*
8. *Seshu P., "Text book of Finite Element Analysis", PHI Learning Private Limited, 2003.*

WEB REFERENCES

1. *www.tbook.com*
2. *www.pollockeng.com*

15MMAE22 - ADVANCED AGILE AND LEAN MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *This course is intended to teach the students about E manufacturing concepts i.e., use of IT in the manufacturing sector and advanced manufacturing systems like Lean manufacturing, Agile manufacturing etc.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Utilize the fundamental principle in transforming conventional manufacturing organisation into E-manufacturing systems.*

CO2 *: Apply the knowledge of various e-manufacturing technologies and their possible implementation.*

CO3 *: Identify the considerations and paradigms needed when selecting, evaluating, and adopting the E-manufacturing concept in the manufacturing industries.*

INTRODUCTION

Introduction - Manufacturing operations - Manufacturing Industries and products - Manufacturing Support systems - E- manufacturing concept. **(5)**

MANUFACTURING STRATEGY

Manufacturing strategy and supply chain - Forecasting systems - Dimensions of manufacturing strategy - Supply chain management concepts - Aggregate planning - Single stage inventory control. **(12)**

LEAN MANUFACTURING

Lean Manufacturing - Principles of lean manufacturing - Lean flow- Two paths of implementing lean manufacturing - methodologies for change- environment for change - Pitfalls in implementing lean manufacturing. **(8)**

AGILE MANUFACTURING

Agile manufacturing - Meaning and definition of Agility - Force pulling towards Agility - Three consequences converging physical products, information and services - Empowerment -Enterprise Integration - Concurrent operations - Planning internal alignment of company - Role of strategic planning departments. **(10)**

E-MANUFACTURING

E-Manufacturing - Concepts of E-Manufacturing - Use of internet in manufacturing industries - E-business technology in manufacturing industry - Scope of applications - Implementation Methodology - Benefits of E- Manufacturing. **(10)**

TOTAL : 45

REFERENCES

1. *William M Feld, "Lean Manufacturing Tools, Techniques and How to Use Them", The St. Lucie Press/APICS Series on Resource Management , 2001.*
2. *Mikell P. Groover., "Automation, Production Systems and Computer - Integrated Manufacturing ", Pearson - Prentice Hall, 2012.*
3. *Ronald G.Askin, " Design and Analysis of Lean Production System ", John Wiley and Sons, 2002 .*
4. *Bedwprth D D, " Integrated Production control systems Management,Analysis, Design ", John Wiley and Sons, Newyork, 2002.*
5. *Vollman T E ," Manufacturing Planning and Control Systems", Galgotia publication, New Delhi,1998.*
6. *Paul Kenneth wright , " 21st Century Manufacturing", Prentice Hall, 2001*
7. *Montgomery J C and Levine L O, "The Transition to Agile Manufacturing - Staying Flexible for Competitive Advantage", ASQC Quality Press, Wisconsin, 1995.*

15MMAE23 - ADVANCED BIOMATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To develop knowledge, understanding and practical experience of synthetic used in different biomedical applications, together with a qualitative understanding of the mechanical behavior of a variety of tissues.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Demonstrate the relationship between the structure of materials and their behavior as a basis for material selection in biomedical applications.*

CO2 : *Examine biocompatibility on the relationship between natural tissue structure, function and mechanical behavior.*

CO3 : *Perform mechanical testing for the determination of the mechanical behavior of different biomedical materials.*

FUNDAMENTALS OF BIOMATERIALS AND BIOCOMPATIBILITY

Overview - Introduction - definition and their Implications - Biomaterial - Biocompatibility - Host response - Cell - Material interactions - Experimental Evaluation of Biocompatibility - In vitro tests - In vivo tests - steps for characterizations of biomaterials - Broad view of fundamentals. **(9)**

MATERIALS FOR ORTHOPEDIC APPLICATIONS

Overview - Introduction - Structure and properties of Hard tissues - Processing and properties of Bioceramics and Bioceramic composites - Calcium Phosphate based biomaterials - Hydroxyapatite - Ceramic composites - Glass ceramics based biomaterials - Mica based glass ceramics - other bioglass ceramics - Bio inert ceramics - Polymeric biomaterials - Polymer composites - HDPE - Hap - Al_2O_3 Hybrid Composites - Metal and Alloys in BioMedical Applications - Issues Limiting performance of metallic biomaterials - Wear of Implants - Corrosion of metallic Implants - Ti based Alloys - Co - Cr - Mo, Ni or Ta - Based Alloys - other non ferrous metals and their alloys - Coating on metals. **(9)**

TITANIUM DENTAL IMPLANTS SYSTEMS

Overview - introduction - requirements for successful implants systems - Biological compatibility - Mechanical compatibility - Morphological compatibility - Osseo integration and Bone / Implant interface - Integrated Implant system. **(9)**

PROCESSING OF BIOMATERIALS

Overview - Introduction - Processing of Biomaterials - metals - ceramics - polymers - Biocomposites - Sterlization - Processing for scale - micro / nano surface modification - micro / nano fabrication - tensile testing, microscopy (SEM,AFM) evaluation. **(9)**

BIOMATERIAL APPLICATIONS

Overview - Introduction - Applications in Medicine , Biology , Artificial Organs - Cardiovascular medical devices - Extracorporeal Artificial organs - Orthopedic Implants - Dental Implantation - Bioadhesive - Opthamologic Applications - Cochlear Prosthesis - Drug delivery - Tissue Engineering - 2D and 3D tissue engineering applications and their mechanical characterization - Array technologies and Specific medical applications. **(9)**

TOTAL : 45

REFERENCES

1. *Joon B Park, Joseph D Bronzino , "Bio Materials - Principles and Applications" , CRC Press, 2010.*
2. *Joon B Park and Lakes.R.S, "Bio Materials - An Introduction", Springer, Newyork, 2009.*
3. *Bikramjit Basu, Ashok kumar and S.Katti, "Advanced Biomaterials - Fundamentals , Processing and Applications", Wiley & Sons Publication, 2009.*
4. *Dee.K.C, Puleo and DA, Bizios R, " An Introduction to Tissue Biomaterial Interactions", Wiley & Sons Publications, 2007.*

15MMAE24 - CONCEPTS AND ANALYSIS OF ROBOT MANIPULATORS

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To get adequate exposure on Kinematics of serial robots.*
- *To learn statics, dynamics & motion control.*
- *To gather knowledge on advanced programming of robots.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Demonstrate statics & dynamics of serial and parallel robots.*

CO2 *: Develop advanced program using robot language.*

INTRODUCTION

Introduction - brief history, basic of robot structure, types, classification and usage, science and technology of robots, degrees of freedom, Grubler's criterion, loop mobility criterion.

KINEMATICS OF SERIAL ROBOTS

Position and orientation of a rigid body, types of transformations, transformation matrix, homogeneous transformations, and representation of joints, links representation- D-H parameters - Examples.

Direct and inverse kinematics problems - serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator. **(9)**

KINEMATICS OF PARALLEL ROBOTS

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-form and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform, screw theory. **(9)**

VELOCITY AND STATICS OF ROBOT MANIPULATORS

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough Stewart platform, Singularity analysis and statics. **(12)**

DYNAMICS OF SERIAL AND PARALLEL ROBOTS

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Simulations using Matlab or ADAMS. **(9)**

MOTION PLANNING AND CONTROL

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/ force control, Advanced topics in non-linear control of manipulators. **(12)**

ADVANCED TOPICS IN ROBOTICS

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's). **(9)**

TOTAL : 60

REFERENCES

1 *Ashitava Ghosal ,Robotics: Fundamental Concepts and Analysis, Oxford University Press Second reprint, May 2012.*

2 *T. Yoshikawa, Foundations of Robotics, PHI, 1990.*

3 *J. P. Merlet, Parallel Robots, Springer, 2nd Edition 2006.*

4 *S. K. Saha, Introduction to Robotics, 2nd Edition, Tata McGraw Hill, 2008.*

5. *Lung-Wen -Tsai, Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Wiley, John Wiley & Sons, 1999.*

15MMAE25 - SMART MATERIALS AND SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gain fundamental knowledge on different types of smart materials and systems and to understand the applications of smart materials in various domains.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Demonstrate and analyze the various types of smart materials and systems.*

CO2 *: Evaluate the characteristics of smart material with different domains.*

CO3 *: Analyze and select a piezoelectric composite material according to the requirement.*

INTRODUCTION AND HISTORICAL PERSPECTIVE

Classes of materials and their usage - Intelligent /Smart materials - Evaluation of materials Science - Structural material - Functional materials - Polyfunctional materials - Generation of smart materials - Diverse areas of intelligent materials - Primitive functions of intelligent materials - Intelligent inherent in materials - Examples of intelligent materials, structural materials, Electrical materials, biocompatible materials etc. - Intelligent biological materials - Biomimetics - Wolff's law - Technological applications of Intelligent materials. **(9)**

SMART MATERIALS AND STRUCTURAL SYSTEMS

The principal ingredients of smart materials - Thermal materials - Sensing technologies - Micro sensors - Intelligent systems - Hybrid smart materials - An algorithm for synthesizing a smart material - Passive sensory smart structures- Reactive actuator based smart structures - Active sensing and reactive smart structures - Smart skins - Aero elastic tailoring of airfoils - Synthesis of future smart systems. **(9)**

ELECTRO-RHEOLOGICAL (FLUIDS) SMART MATERIALS

Suspensions and electro-rheological fluids - Bingham-body model - Newtonian viscosity and non-Newtonian viscosity - Principal characteristics of electro rheological fluids - The electrorheological phenomenon - Charge migration mechanism for the dispersed phase - Electrorheological fluid domain - Electrorheological fluid actuators - Electro-rheological fluid design parameter - Applications of Electrorheolgoical fluids. **(9)**

PIEZOELECTRIC SMART MATERIALS

Background - Electrostriction - Pyroelectricity - Piezoelectricity - Industrial piezoelectric materials - PZT - PVDF - PVDF film - Properties of commercial piezoelectric materials - Properties of piezoelectric film (explanation) - Smart materials featuring piezoelectric elements - smart composite laminate with embedded piezoelectric actuators - SAW filters. **(9)**

SHAPE - MEMORY (ALLOYS) SMART MATERIALS

Background on shape - memory alloys (SMA) Nickel - Titanium alloy (Nitinol) - Materials characteristics of Nitinol - Martensitic transformations - Austenitic transformations - Thermoelastic martensitic transformations - Cu based SMA, chiral materials - Applications of SMA - Continuum applications of SMA fastners - SMA fibers - reaction vessels, nuclear reactors, chemical plants, etc. - Micro robot actuated by SMA - SMA memorisation process (Satellite antenna applications) SMA blood clot filter - Impediments to applications of SMA - SMA plastics - primary molding - secondary molding - Potential applications of SMA plastics. **(9)**

TOTAL : 45

REFERENCES

1. *M.V.Gandhi and B.S. Thompson, Smart Materials and Structures, Chapman and Hall, London, First Edition, 1992.*
2. *T.W. Deurig, K.N.Melton, D.Stockel and C.M.Wayman, Engineering Aspects of Shape Memory Alloys, Butterworth -Heinemann, 1990.*
3. *C.A.Rogers, Smart Materials, Structures and Mathematical Issues, Technomic Publising Co., USA, 1989.*

15MMAE26 - ULTRASONIC AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gain fundamental knowledge on ultrasonic transducers and determine the velocity of propagation and absorption in different mediums and to use this principle to solve various real life problems.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Compute the propagation of ultrasonic waves in different medium.*

CO2 *: Determine the velocity of propagation of ultrasound.*

CO3 *: Apply ultrasonic principle to various real-world problems.*

ULTRASONIC TRANSDUCERS

Piezoelectric and Magnetostrictive transducers - equivalent circuits - Efficiency - Transducer mounting Mechanical and Electronics, linear and sector transducers - variable frequency systems. **(9)**

ABSORPTION OF ULTRASONIC RADIATION

Classical absorption due to viscosity - Absorption due to thermal conductivity - Relaxation process - Evaluation of dispersion and absorption curves - structural relaxation - relation between collision frequency and relaxation time - Ultrasonic attenuation in solids. **(9)**

ULTRASONIC PROPAGATION IN SOLIDS AND LIQUIDS

Propagation of Ultrasonic waves in solids - Plane wave propagation - Relation between velocity of sound and elastic properties - Adiabatic and Isothermal elastic constants - Ultrasonic propagation in liquids - Internal pressure and free volume calculations. **(9)**

DETERMINATION OF VELOCITY OF PROPAGATION OF ULTRASOUND

Transit time method - Pulse Echo methods - Acoustic Interferometry - Measurements at high pressure and high temperature - Transducer coupling materials. **(9)**

APPLICATION OF ULTRASONICS

Industrial applications - Medical Applications - Acoustic microscope - Acoustic hologram - ultrasonic transaxial tomography. **(9)**

TOTAL : 45

REFERENCES

1. *G.L.Gooberman, Ultrasonics - Theory and Applications, - The English Universities Press Ltd., London, 1968.*
2. *Schreiber, Anderson and Soga, Elastic Constants and Their Measurement, Mc Graw Hill Book Co., New Delhi, 2007.*
3. *R.A.Lerski (Editor), Practical Ultrasound, IRL Press, Oxford,1988.*
4. *Robert T.Beyer and Stephen V. Letcher, Physical Ultrasonics, Academic Press, London, 1969.*

15MMAE27 - VIBRATION ANALYSIS AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gain fundamental knowledge on vibration analysis for both single and multi-degreeof-freedom systems and to understand various vibration control methods.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Analyze a given physical problem and develop a simple mathematical model.*

CO2 *: Simplify non-linear vibratory systems in order to analyze as linear problems.*

CO3 *: Determine overall response of a vibratory system based on initial conditions.*

FUNDAMENTALS OF VIBRATION

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers -.Response To Arbitrary and non- harmonic Excitations - Transient Vibration - Impulse loads-Critical Speed of Shaft-Rotor systems. **(9)**

TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration of Undamped and Damped- Forced Vibration with Harmonic Excitation System -Coordinate Couplings and Principal Coordinates **(9)**

MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

Multi Degree Freedom System -Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix - Eigen Values and Eigen Vectors-Matrix Iteration Method -Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method - Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams **(9)**

VIBRATION CONTROL

Specification of Vibration Limits -Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing - Vibration Control by Design Modification- - Active Vibration Control **(9)**

EXPERIMENTAL METHODS IN VIBRATION ANALYSIS

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic and Electrodynamics -Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes **(9)**

TOTAL : 45

REFERENCES

1. *Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.*
2. *Thomson, W.T. - "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.*
3. *Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.*
4. *S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw -Hill Publishing Com. Ltd., New Delhi, 2007.*

15MMAE28 - DESIGN OF EXPERIMENTS AND TAGUCHI METHODS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide details about the various techniques involved in Design of Experiments.*
- *To gain knowledge to solve complex engineering problems*
- *To acquire the essential knowledge on Multi-level experiments and Multi-response optimization.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Select the appropriate experimental techniques for solving the complex problems.*

CO2 : *Demonstrate the acquired knowledge to solve real time problems, involving several parameters.*

CO3 : *Apply the Taguchi Quality philosophy, Taguchi's Loss Function, and to assess the loss impact of process centering and variation reduction efforts.*

EXPERIMENTAL DESIGN FUNDAMENTALS

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models. **(6)**

SINGLE FACTOR EXPERIMENTS

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests. **(9)**

MULTIFACTOR EXPERIMENTS

Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2K factorial Experiments. **(9)**

SPECIAL EXPERIMENTAL DESIGNS

Blocking and confounding in 2k designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods. **(9)**

TAGUCHI METHODS

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization. **(12)**

TOTAL : 45

REFERENCES

1. *Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI Learning Private Ltd., 2012.*

2. *Montgomery, D.C., Design and Analysis of Experiments, John Wiley and Sons, Eighth Edition, 2012.*
3. *Nicolo Belavendram, Quality by Design; Taguchi Techniques for Industrial Experimentation, Prentice Hall, 1995.*
4. *Phillip J.Rose, Taguchi Techniques for Quality Engineering, McGraw Hill, 1996.*
5. *Montgomery, D.C., Design and Analysis of Experiments, Minitab Manual, John Wiley and Sons, Seventh Edition, 2010.*

15MMAE29 - METAL CUTTING THEORY AND PRACTICE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To make the students familiar with various principles of metal cutting, cutting tool materials and its wear mechanisms during machining operations*
- *To determine physical and design interpretations of metal cutting parameters in design of machine tools.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Perform cutting force analysis of metal cutting machines.*

CO2 *: Perform economics of machining and tool life estimation.*

INTRODUCTION

Need for rational approach to the problems of cutting materials - observations made in the cutting of metals - basic mechanism of chip formation - thin and thick zone modes - types of chips - orthogonal Vs oblique cutting - force relationship for shear plane angle in orthogonal cutting - energy consideration in machining - Merchant, Lee and Shafter theories - critical comparison. **(9)**

SYSTEM OF TOOL NOMENCLATURE

Single point cutting tool - System of tool nomenclature and conversion of rake angles - nomenclature of multi point tools like drills, milling - conventional Vs climb milling, mean cross sectional areas of chip in milling - specific cutting pressures. **(9)**

THERMAL ASPECTS OF MACHINING

Heat distribution in machining - effects of various parameters on temperature - method of temperature measurement in machining - hot machining - cutting fluids. **(9)**

TOOL MATERIALS, TOOL LIFE AND TOOL WEAR

Essential requirements of tool materials - development in tool materials - ISO specification for inserts and tool holders - tool life - conventional and accelerated tool life tests - concepts of mach inability index - economics of machining. **(9)**

WEAR MECHANISMS AND CHATTER IN MACHINING

Processing and machining - measurement techniques - Reasons for failure in cutting tools and forms of wear - mechanisms of wear - chatter in machining - factors effecting chatter in machining - types of chatter - mechanism of chatter. **(9)**

TOTAL : 45

REFERENCES

1. *Boothroid D.G & Knight W A., Fundamentals of Machining and Machine Tools, Marcel Dekker, New York 1989.*
2. *Shaw.M.C., Metal Cutting Principles,Oxford Clare Don Press, 1984.*
3. *Bhattacharya.A., Metal Cutting Theory and Practice, Central Book Publishers, India, 1984.*

15MMAE30 - DIGITAL TOPOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To present an introduction to the field of topology, with emphasis on those aspects of the subject that are basic to higher mathematics.*
- *To introduce the properties and features of 2D and 3D images correspond to topological properties*
- *To provide knowledge on various image analysis algorithms.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Demonstrate the acquired knowledge of properties and features of two-dimensional (2D) or three-dimensional (3D) digital images that correspond to topological properties.*

CO2 *: Use the image analysis algorithms, to solve real time problems.*

GENERAL TOPOLOGY

Set theory and logic - Continous functions - connectedness and compactness - compatibility and separation axiom - the Tychonoff theorem - Matrization theorem and Para compactness - metric spaces - Baire spaces **(9)**

ALGEBRIC TOPOLOGY

Fundamental group - Seperation theory - The seifert - Van kampen V - Classification of surfaces - Classification of covering surfaces - application to group theory **(9)**

TRANSFORM I

Wavelet transforms - Introduction to Linear Algebra - Haar and Daubenchies Wavelets - Orthonormal Wavelets - Differential Equations - Time frequencies signal analysis. **(9)**

TRANSFORM II

Z- transforms - inverse transforms - Solution Differential Equations - Discrete Convolution (linear and circular) - Discrete time fourier transforms - fast fourier transforms - decimation in time algorithm - decimation in frequency algorithm - Computation of inverse discrete fourier transforms. **(9)**

RANDOM PROCESS

Classification - SSS process - Analytical Representation of RP - Auto correlation - Cross Correlation - Mean Ergodic process - Power spectral density function - Gaussian process - Poisson process - Markov process. **(9)**

TOTAL : 45

REFERENCES

1. *James R Munkers., Topology, Pearson Education, Prentice Hall 2015.*
2. *Lokenath D Ebnath By Birkhanger, "Wavelet Transforms and Time Frequency Signal Analysis, 2015.*
3. *Veerarajan R., Probability Statiscs and Random Process, 2nd Edition, Tata McGraw-Hill Education, 2008.*

15MMAE31 - AUTOMOTIVE SUSPENSION AND SYSTEM DYNAMICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To introduce the fundamental theory of vehicle dynamics, vehicle performance as well as related tests and regulations*
- *To demonstrate the knowledge of dynamic modeling and analysis in vehicle design*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Analyze the influence of vehicle configuration and design parameters on vehicle performance*

CO2 *: Conduct dynamic modeling and analysis of vehicle design*

INTRODUCTION TO VEHICLE DYNAMICS

Classification of vibration, Definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies - Model of an automobile, one degree of freedom, two degree of freedom system, Free, forced and damped vibrations. Magnification factor and transmissibility, Vibration absorber. **(9)**

SUSPENSION SYSTEM

Types of suspension, Factors influencing ride comfort, Types of suspension springs Independent suspension - front and rear, Rubber, pneumatic, hydro elastic suspension, shock absorber. Types of wheels - construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres. **(9)**

DYNAMICS OF SUSPENSION SYSTEM

Requirements of spring mass Frequency, wheel hop, wheel wobble, wheel shimmy, choice of suspension, spring rate. Calculation of effective spring rate. Vehicle Suspension in fore aft. Hydraulic damper and choice of damping characteristics. Compensated suspension systems. **(9)**

BRAKING SYSTEM

Types of brakes, principle of shoe brakes, constructional Details - materials, braking torque developed by leading and trailing shoes. Disc brake theory, constructional details, advantages, brake actuating systems, Factors affecting brake performance, Exhaust brakes, power assisted brakes, testing of brakes. **(9)**

SENSORS AND MICROPROCESSORS IN AUTOMOBILES

Basic sensor Arrangement. Types of sensors - oxygen sensors, fuel metering/vehicle speed sensor, pressure sensor. Microprocessor and microcomputer controlled devices in automobiles such as Instrument cluster, Voice warning system, keyless entry system, and Automatic transmission. Environmental requirements (vibration, Temperature and EMI) **(9)**

TOTAL : 45

REFERENCES

1. *P.M. Heldt, 'Automotive Chassis' Chilton Co., Newyork, 1992.*
2. *W.Steeds, 'Mechanics of Road Vehicle', IIliffe Books Ltd, London, 1990.*
3. *J.Y.Wong, 'Theory of Ground Vehicle', John Wiley Sons, New York.*
4. *Robert N.Brady, Automotive Computers & Digital Instrumentation, Prentice Hall, New Jersy, 1988.*
5. *N.K.Giri,'Automobile Mechanics' Khanna Publishers, New Delhi, 1999.*

15MMAE32 - CONGNITIVE ERGONOMICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To introduce various concepts of cognitive ergonomics.*
- *To provide different methodologies employed in the field to understand safety promotion/injury prevention, work design, and work/job assessment*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Apply ergonomics principles for promoting to safety, health and productivity.*

CO2 *: Outline the process of ergonomics risk assesments.*

CO3 *: Effectively design workplace layout according to ergonomic considerations.*

CO4 *: Identify environmental aspects of a good ergonomics design.*

HUMAN MACHINE INTERFACE (HMI)

Inter disciplinary aspects of Human factor Engineering, Cognitive Psychology Concept and Principle of HMI, Development of User interface design, Usernomics, methods for usability evaluation. **(9)**

IMAGERY

Cognition - Perceptual Process -Sensory Memory, Patten Recognition, Attention , Attention deficit disorder, Memory- Models of memory, Atkinson - Shiffrin Model , Levels of Processing approach , Short term & Long Term Memory and Improving memory. **(9)**

VISUAL COGNITION

Cognitive approach of Vision & Illumination Design-color vision, Measurement of Visual acuity , Aging Eye, Illumination at work, mental Image ability - Characteristics of Mental Images - Imagery and Rotation, size , angle Shape , and Part -whole Relationship , Imagery and Interference Imagery & Memory , Cognitive maps. **(9)**

ENVIRONMENTAL FACTORS

Noise and Vibration - Measurement of sound, Hearing protectors, reduction of noise, effects of noise on Human performance, Interference of noise with spoken communication, Whole body vibration, sources of vibration discomfort. **(9)**

SHIFT WORK

Problems with shift work, Improving Shift work, Shift work schedule, selection of Individuals for shift work. **(9)**

TOTAL : 45

REFERENCES

1. *Martin Helander, A guide to Human Factors & Ergonomics, Taylor & Francies, CRC Press, Second Edition, 2006.*
2. *R.S.Bridger, Introduction to Ergonomics, McGRAW- HILL, INC. 2003.*
3. *John Long, A.Whitefield, Cognitive Ergonomics and Human-Computer Interaction, Cambridge University Press, 1989.*
4. *The Models of Cognition and Perception (collections from International Journals of Cognitive Psychology), Vol. 18 (ISSN: 0010-0277), Elsevier Science Publisher, Amsterdam, Netherlands, 1986.*

15MMAE33 - OPTIMIZATION TECHNIQUES IN MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To understand the major capabilities and limitations of deterministic operations research modeling as applied to problems in engineering applications.*
- *To recognize, formulate and to use prepared computer programs to solve linear and non-linear constrained/unconstrained problems.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 *: Apply current knowledge and adapt to emerging applications in manufacturing.*

CO2 *: Conduct, analyze and interpret experiments and apply experimental results to improve processes.*

CO3 *: Apply creativity in the design of systems, components or processes appropriate to program objectives.*

INTRODUCTION

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems. **(9)**

CLASSIC OPTIMIZATION TECHNIQUES

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming. **(9)**

NON-LINEAR PROGRAMMING

Introduction – Lagrangian Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming **(9)**

INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem. **(9)**

ADVANCES IN SIMULATION

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems. **(9)**

TOTAL : 45

REFERENCES

1. *Rao S.S., “Engineering Optimization - Theory and Practice”, New Age International Private Limited, 2010.*
2. *Kalyanamoy Deb, “Optimization for Engineering Algorithms and Examples, Prentice Hall of India, 2011.*
3. *M. C. Joshi, Kannan M. Moudgalya, “Optimization: Theory and Practice”, Narosa Publishing House, 2013.*
4. *Johnson Ray. C., “Optimization Design of Mechanical Elements”, John Wiley & Sons, 1981.*
5. *David E Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson Education India, 2004.*

15MCHE18 - RISK ANALYSIS, ASSESSMENT AND MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To develop a working vocabulary of the common terms used in Risk Assessment.*
- *To become familiar with the framework of how a risk assessment is performed and used.*
- *To develop an understanding of the uses and limitations of risk analysis in chemical industries.*
- *To design, implement and execute process of risk management practices.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

CO1 : *Apply knowledge of mathematics, science and engineering to the assessment of risk.*

CO2 : *Identify, formulates and solves engineering problems on the area risk management.*

CO3 : *Have a sound knowledge to use the techniques, skills and modern engineering tools necessary for risk management practice.*

CO4 : *Utilize a range of popular risk analysis techniques innovatively to examine risk problems in chemical industries.*

GENERAL

Risk types, Completion, Permitting, Resources, Operating, Environmental, Manageable, Insurable, Risk Analysis types clauses. **(9)**

TECHNIQUES

General, Risk adjusted discounted rate method. Certainty Equivalent Coefficient method. Quantitative Sensitivity analysis, Probability distribution, coefficient of variation method, Simulation method, Crude Procedures, Payback period, Expected monetary value method, Refined procedures, Shackle approach. Hiller's model, Hertz model, Goal programming. **(9)**

RISK MANAGEMENT

Emergency relief systems, Diers program, Bench scale experiements, Design of emergency relief systems, Internal emergency planning, Risk management pan, Madatory technology, option analysis, Risk managment alternatives, risk managment tools, risk mangement plans, Risk index method, Dowfire and explosion method, Mond Index Method. **(9)**

RISK ASSURANCE AND ASSESSMENT

Property Insurance, Transport insurance, Liability insurance, Pecunious insurance, Risk assessment, Scope convey study, Rijimond pilot study, Low probability hig consequence events, Fault tree analysis, Event tree analysis, Zero infinity dilemma. **(9)**

RISK ANALYSIS IN CHEMICAL INDUSTRIES

Handling and storage of chemicals, process plants, Personnel protection eqipment, Environmental risk analysis, International enviromental management system, Corporate management system, Enviornmental risk assessment. Total quality management, Paradigms and its convergence. **(9)**

TOTAL : 45

REFERENCES

1. *Srivastava. S.K., Industrial Maintenance Managment, Sultan Chand and Co., 2002.*
2. *Rao. P.C.K., Project Managment and Control, Sultan Chand and Co., 1996.*
3. *Sincero. A.P., Sincero G.A., Environmental Engineering - A Design Approach, Prentice Hall of India, 1996.*
4. *Pandya. C.G., Risks in chemical units, Oxford and IBH Publishers, 1992.*
5. *Fawcett, H.H. Safety and Accident Prevention in Chemical operations by John Wiley and Sons, 1982.*
6. *Kind, R.W. Industrial Hazard and Safety Handbook, Butterwork, 1982.*
7. *Steiner. H.M., Engineering Economic Principles, Mc Graw Hill Book Co., New York, 1996.*