

COIMBATORE INSTITUTE OF TECHNOLOGY

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

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)



Department of Electrical and Electronics Engineering

M.E. Applied Electronics

Curriculum and Syllabi

Under Choice Based Credit System

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

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COIMBATORE INSTITUTE OF TECHNOLOGY

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

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in engineering along with realized 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 of CIT 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 ELECTRICAL AND ELECTRONICS ENGINEERING
COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF THE
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To empower graduates with capabilities of Academic, Technical and Professional competence and to nurture them in the emerging fields of research, and innovative product development.

MISSION

1. Facilitate the development of students through a broad-based technology oriented education in the field of EEE.
2. Emphasize the application of emerging technologies to solve problems in the fields of EEE.
3. Design and develop products with creativity.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the AE programme will be able to fulfill all of the following programme educational objectives for the curriculum :

1. The engineers of Applied Electronics, design circuits and develop systems in contemporary and frontier areas of electronics.
2. The enhanced skills of the engineers meet the demands and expectations of automation in various industries.
3. The graduates with professional competency promote and support creative research towards innovative product development.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME OUTCOMES (POs)

POs	Graduate Attributes	Programme Outcome
PO1	Knowledge - Basics	An ability to integrate knowledge from the fields of study and arrive solutions for complex engineering tasks.
PO2	Critical - Thinking	An ability to understand different kinds of problem solving methods through the imparted domain knowledge.
PO3	Problem - Solving	To solve a broad research competence problem systematically, to analyze the reasonable value of new ideas and technology decisions with confidence.
PO4	Research - Skill	An ability to empower with an in-depth understanding of research orientation in their chosen domain with a strategy.
PO5	Usage of Modern tools	An ability to design an ICT based system for optimal analysis of systems.
PO6	Multidisciplinary work	An ability to stimulate opportunities to contribute skills thereby providing an option to find applications suiting the revolutionized concepts.
PO7	Project management	To research and implement a project that meets the needs within realistic constraints.
PO8	Continuous Learning	To inculcate a desire for continuous learning and creativity, with emerging tools and technology.
PO9	Ethical Practices and social responsibility	An ability to understand the responsibility of taking professional decisions based on the impact of socio- economic issues.
PO10	Independent reflective learning	To develop the self-confidence towards the professional competency with interpersonal skills.
PO11	Collaborative Work	To develop a skill in conducting research in their chosen field, and present their results and findings in scientific forums.
PO12	Leadership Quality	An ability to deliver inspiring thoughts and show unparalleled commitment.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Curriculum from the Academic Year 2015 - 2016 onwards

Under Choice Based Credit System

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

Specialization : Applied Electronics

Semester I

Course Code	Course Name	L	T	P	Credits	Type
15MA11	Linear Algebra and Stochastic Processes	4	0	0	4	FC
15MA12	Statistical Signal Processing	3	2	0	4	PC
15MA13	Embedded processors	3	0	0	3	PC
15MA14	Power Conversion Techniques for Industrial Systems	3	0	0	3	PC
15MA15	Smart Systems	3	0	0	3	PC
	Elective I	3	0	0	3	PE
15MA16	Embedded Processors Laboratory	0	0	2	1	PC
	TOTAL				21	

Semester II

Course Code	Course Name	L	T	P	Credits	Type
15MA21	Modern Control Theory	3	0	0	3	PC
15MA22	Robotics Technology and Intelligence	3	0	0	3	PC
15MA23	Embedded system Design using FPGA	3	2	0	4	PC
	Elective II	3	0	0	3	PE
	Elective III	3	0	0	3	PE
15MA24	Robotics Laboratory	0	0	2	1	PC
	Employability Enhancement Course*	0	0	4	2	EEC 1
	TOTAL				19	

Semester III

Course Code	Course Name	L	T	P	Credits	Type
	Elective IV	3	0	0	3	PE
	Elective V	3	0	0	3	PE
	Elective VI	3	0	0	3	PE
	TOTAL				9	

Semester IV

Course Code	Course Name	L	T	P	Credits	Type
15MA41	Project Work & Viva Voce				18	EEC 2
	TOTAL				18	

Grand Total Credits : 67

(Note : FC - Foundation Course; PC - Professional Core; PE - Professional Elective;
EEC - Employability Enhancement Course)

LIST OF PROFESSIONAL ELECTIVES

Sl. No.	Course Code	Course Name	L	T	P	C	Type
		INDUSTRIAL ENGINEERING					
1	15MAE01	Electromagnetic Interference and Compatibility	3	0	0	3	PE
2	15MAE02	Automation and Control of Industrial Systems	3	0	0	3	PE
		POWER AND ENERGY					
3	15MAE03	Distributed Generation and Smart Grid	3	0	0	3	PE
4	15MAE04	Electrical Energy Systems Design	3	0	0	3	PE
5	15MAE05	Power Quality	3	0	0	3	PE
		CONTROL AND AUTOMATION					
6	15MAE06	Optimal control	3	0	0	3	PE
7	15MAE07	Robust control	3	0	0	3	PE
8	15MAE08	System identification and adaptive control	3	0	0	3	PE
		ELECTRONIC SYSTEM DESIGN					
9	15MAE09	ASIC and FPGA Design	3	0	0	3	PE
10	15MAE10	Synthesis and Optimization of Digital Circuits	3	0	0	3	PE
11	15MAE11	Digital System Design and Testing	3	0	0	3	PE
		COMPUTER AND COMMUNICATION					
12	15MAE12	High Speed Communication Circuits	3	0	0	3	PE
13	15MAE13	High Performance Computer Architecture	3	0	0	3	PE
14	15MAE14	Computer Vision	3	0	0	3	PE
15	15MAE15	Visible Light Communication	3	0	0	3	PE

*** List of Employability Enhancement Courses - Anyone in Semester II under Continuous Assessment Scheme**

Sl. No.	Course Code	Course Name	L	T	P	C	Type
1	15MAEE01	Feasibility report preparation	0	0	4	2	EEC
2	15MAEE02	Prototype development	0	0	4	2	EEC
3	15MAEE03	Modelling and Simulation - A Case study	0	0	4	2	EEC
4	15MAEE04	Industrial Training.	0	0	4	2	EEC
5	15MAEE05	Online Certification course conducted by registered Organizations	0	0	4	2	EEC

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Curriculum from the Academic Year 2015 - 2016 onwards

Under Choice Based Credit System

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

Specialization : Applied Electronics

Semester I

Course Code	Course Name	L	T	P	Credits	Type
15MA11	Linear Algebra and Stochastic Processes	4	0	0	4	FC
15MA12	Statistical Signal Processing	3	2	0	4	PC
15MA13	Embedded processors	3	0	0	3	PC
	TOTAL				11	

Semester II

Course Code	Course Name	L	T	P	Credits	Type
15MA21	Modern Control Theory	3	0	0	3	PC
15MA22	Robotics Technology and Intelligence	3	0	0	3	PC
15MA23	Embedded system Design using FPGA	3	2	0	4	PC
	TOTAL				10	

Semester III

Course Code	Course Name	L	T	P	Credits	Type
15MA14	Power Conversion Techniques for Industrial Systems	3	0	0	3	PC
15MA15	Smart Systems	3	0	0	3	PC
	Elective I	3	0	0	3	PE
15MA16	Embedded Processors Laboratory	0	0	2	1	PC
	TOTAL				10	

Semester IV

Course Code	Course Name	L	T	P	Credits	Type
	Elective II	3	0	0	3	PE
	Elective III	3	0	0	3	PE
15MA24	Robotics Laboratory	0	0	2	1	PC
	Employability Enhancement Course*	0	0	4	2	EEC 1
	TOTAL				9	

Semester V

Course Code	Course Name	L	T	P	Credits	Type
	Elective IV	3	0	0	3	PE
	Elective V	3	0	0	3	PE
	Elective VI	3	0	0	3	PE
	TOTAL				9	

Semester VI

Course Code	Course Name	L	T	P	Credits	Type
15MA41	Project Work and Viva voce				18	EEC 2
	TOTAL				18	

Grand Total Credits : 67

15MA11 - LINEAR ALGEBRA AND STOCHASTIC PROCESSES

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

To provide the students the mathematical background required to learn the subjects of their specialization

COURSE OUTCOME

CO1 : To understand the knowledge of mathematical skills behind various topics.

CO2 : To cultivate a mathematical attitude and nurture the interests.

CO3 : To train the engineers who can work on real life challenging problems.

LINEAR ALGEBRA

Vector spaces - Subspaces - Basis and Dimension - Linear transformation - Rank and Nullity - Inner product space - Gram Schmidt process - Least square problems. **(12)**

LINEAR AND NONLINEAR PROGRAMMING PROBLEMS

Linear Programming Problems - Simplex method - Big M technique - Duality - Simple Problems Game Theory - Non linear programming problems - Graphical Solution - Kuhn- Tucker conditions with non negative constraints. **(12)**

APPLIED PROBABILITY

Probability - Axionas - Conditional Probability - Baye's theorem - One and Two dimensional random variables - Expectation - Conditional expectation - Correlation - Probability Distributions - Binomial, Poisson, Uniform Exponential, Normal and Weibullll distributions - Chebyshev's inequality - Central limit theorem. **(12)**

STOCHASTIC PROCESSES

Classification of random processes - Strictly and wide sense stationary processes - Ergodic process - Auto correlation - Cross correlation - Properties and problems - Power spectral density functions. **(12)**

SPECIAL RANDOM PROCESSES

Markov process - Poisson process - Gaussian process - Linear time invariant systems - Linear system with random inputs - Auto correlation and cross correlation functions of input and output. **(12)**

TOTAL : 60

TEXT BOOKS

1. *Gilbert Strang, Linear Algebra and its applications, Harcourt Brace Jovanovich Publishers 3rd Edition 1988 San Diego ISBN : 0-15-551005-3.*
2. *Hamdy A. Taha, Operations Research An Introduction, Prentice Hall of India Private Limited, 9th Edition 2010, New Delhi, ISBN-13: 978-0132555937.*
3. *Sheldon M. Ross, "Introduction to Probability models", Eleventh edition Academic Press, 2014. ISBN-13:978-0124079489*

REFERENCES

1. *David C Lay, Linear Algebra and its applications Pearson Education Publishers 3rd Edition 2004. ISBN.*
2. *KantiSwarup, P.K. Gupta and Man Mohan, Operations Research Sultan Chand and Sons (Jain Book Agency Publishers Paper Back) 17th Edition 2014 Reprint New Delhi ISBN : 9789351610236.*
3. *Veerarajan T, Probability, Statistics and Random Processes Tata McGraw-Hill Education Publishing Private Limited 3rd Edition , 2008 New Delhi ISBN 13: 9780070669253.*

15MA12 - STATISTICAL SIGNAL PROCESSING

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce and explore the relationships between four very important signal processing problems: signal modeling, optimum filtering, spectrum estimation and adaptive filtering

COURSE OUTCOME

CO1 : Knowledge about modeling stationary Systems and estimate Power Spectral Density

CO2 : Understanding of Error correcting algorithms

CO3 : Need for adaptive systems and adaptive filters

STOCHASTIC PROCESSES AND MODELS

Partial Characterization of Discrete time stochastic process - Mean Ergodic Theorem - Correlation matrix of sine wave plus noise -Stochastic Models : Autocorrelation method - covariance method-WOLD Decomposition - Yule - Walker equations - Power Spectral density - Properties. **(9+6)**

POWER SPECTRUM ESTIMATION

Nonparametric models: The periodogram - Barlett's method:Periodogram Averaging - Welch's Method: Averaging Modified Periodograms - Blackman-Tuckey Approach: Periodogram smoothing- The maximum entropy method .

Parametric methods : Autoregressive, Moving average, ARMA methods Frequency estimation : Eigen decomposition of the autocorrelation matrix - Barlett frequency estimation -Autoregressive frequency Estimation **(9+6)**

ESTIMATION OF STATIONARY PROCESSES

Wiener Filters : Linear optimum filtering - Principle of orthogonality -Wiener Hopf equations - error performance surface - Levinson -Durbin algorithm - Wiener filter **(9+6)**

ESTIMATION OF NON-STATIONARY PROCESSES

Least squares principle - Quadratic forms - Minimum energy principle- Least squares solution - weighted least squares - recursive least squares - Least Mean Squares algorithm - Kalman filter **(9+6)**

ADAPTIVE FILTERS AND MULTIRATE SYSTEMS

Channel Equalizer - Echo cancellor - Noise cancellation- Sampling rate conversion - interpolation and decimation - application to subband coding - wavelet transforms and wavelet packets **(9+6)**

TOTAL : 45 +30 = 75

REFERENCES

1. *Simon Haykin, Thomas Kailath, "Adaptive Filter Theory", Pearson Education, 4th Edition, 2005.*
2. *Monson H.Hayes,"Statistical Digital Signal Processing and Modeling", Wiley India, 2013.*
3. *M.D.Srinath, P.K. Rajasekaran, R.Viswanathan, "Introduction to Statistical Signal Processing with Applications", Pearson Education, 2003.*

15MA13 - EMBEDDED PROCESSORS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To provide exposure to the students on microcontroller, their architecture and choose appropriate microcontroller for a real time application programming techniques.

COURSE OUTCOME

The students can

- CO1** : *learn to develop the hardware for embedded system application based on the processors.*
- CO2** : *Incorporate suitable microcontroller along with appropriate interfacing circuits and implement the same for an application with software programs.*
- CO3** : *explore the features of the microcontrollers and provide apt solutions for any embedded application.*

PIC MICROCONTROLLER - ARCHITECTURE

PIC Architecture- RISC Architecture-program memory organization-PIC bank switching, table processing, macros and modules-PIC configuration registers-ROM loaders-timer programming timers 0 and 1-programming timers 2 and 3-serial port programming-interrupt programming. **(9)**

PIC INTERFACING

ADC, DAC and sensor interfacing-erasing and writing to flash-reading and writing to data EEPROM-standard and enhanced CCP modules-compare mode programming-capture mode programming-PWM programming- ECCP programming. **(9)**

ARM ARCHITECTURE

ARM7TDMI programmers model-processor modes-program status registers-vector table-assembler rules and directives-predefined register names-macros-assembler operators-literals-load and store instructions-operand addressing-endianness-ARM rotation scheme-loading constants and addresses into registers. **(9)**

ARM PROGRAMMING

Data processing operations-loops and branches-LUT-Jump tables-binary searches -LDM/STM instruction-full/empty ascending/descending stacks-subroutines-passing parameters: in registers, by reference, on the stack-ARM APCS-exception handling-memory mapped peripherals-LPC2104-LPC 2132-Thumb Instruction set-Thumb programmers model-Thumb branch instructions- Thumb Data processing instructions-Thumb single register data transfer- Thumb multiple register data transfer instructions Thumb implementation. **(9)**

EMBEDDED APPLICATIONS

Two digits multiplexed 7 segment LED-LED Counter with timer Interrupt-calculator with keypad -PWM motor control with CCP-read CID register and display on a PC screen-Read write SD cards-USB based pressure display. **(9)**

TOTAL : 45

REFERENCES

1. *Muhammad Ali Mazidi, "PIC Microcontrollers and Embedded Systems Using Assembly and C for PIC18", Pearson Education, 2008.*
2. *William Hohl, "ARM Assembly Language", CRC Press, 2012.*
3. *John B. Peatman, "Design with PIC microcontrollers", Pearson Education, Singapore - 1998.*
4. *Andrew Sloss, Dominic Symes, and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System", the Morgan Kaufmann Series, 2004.*
5. *Steve Furber, "ARM System-on-Chip Architecture", Addison-Wesley Professional; II edition 2000.*
6. *ARM Architecture Reference manual, ARM Limited.*
7. *Ajay V Desmukh, "Microcontrollers: Theory and Applications", Tata McGraw Hill, New Delhi, 2005.*

15MA14 - POWER CONVERSION TECHNIQUES FOR INDUSTRIAL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To facilitate the students to comprehend the impact of power electronics in the power & energy systems of modern industries and to afford innovative solutions by addressing their needs.

COURSE OUTCOME

At the end of the course the students will be able to:

- CO1** : Realize the extensive applications of power electronics in global industrialization
- CO2** : Analyze the dynamic and steady-state operation of power electronic converters and to provide the solutions required for industries.
- CO3** : Work autonomously for the design, modeling, development and testing of power electronics systems

LINE COMMUTATED CONVERTERS-I

Principles and Methods of Electric Power Conversion - Impact of Power Electronics on Energy Systems -Generic Power Converter -Power Flow Control by Switches, Attributes of a Practical Switch-Requirement of Power Converters in Industries.

Controlled Converters - Semi and Full Bridge Converters - Dual Converters -- Twelve Pulse Converters - PF Improvement - Reactive power and harmonic considerations and analysis-PWM Rectifiers- Devices Selection. **(9)**

LINE COMMUTATED CONVERTERS-II

AC Voltage Controllers - Principle of operation-- Single Phase and Three Phase AC Voltage Controllers - Single Phase Transformer Connection Changers - Design of AC Voltage Controllers.

Cyclo Converters: Single Phase and Three Phase Cyclo Converters - Input Current Wave form and Harmonics **(6)**

CHOPPERS AND RESONANT CONVERTERS

Static DC Switches - Basic Converter Circuits: Buck Converter, Boost Converter, Buck-Boost Converter- Cük Regulator - SEPIC Converter- Synchronous and Bi-directional Converters.

Isolated Switch Mode Power Supplies: Flyback Converter- Forward Converter-Bridge Converter-Push-Pull Converter- Switch Mode Power Supplies with multiple outputs- Practical Design Considerations.

Resonant and soft switching converters: Introduction - Classification - Resonant Switch - ZVS and ZCS Techniques - Two quadrant Resonant Converters - Class E Resonant Converters- Comparison of ZCS and ZVS topologies **(11)**

INVERTERS AND AC-AC CONVERTERS BASED ON COMPLETELY

CONTROLLABLE SWITCHES

Single Phase and Three Phase Bridge Voltage Sources Inverters -Pulse width modulated inverters-Space Vector PWM - Current Source Inverters - Boost Inverters -Multi level Inverters - Introduction - Multilevel Concepts - Types - Operation - Comparison - Multi Cell Converters- Reactive power and harmonic considerations and analysis.

AC Voltage Controllers with PWM Control -Matrix Converter - Operation and Control Methods **(10)**

MODELING, SIMULATION AND INDUSTRIAL APPLICATIONS OF POWER ELECTRONIC SYSTEMS

Introduction - Modeling of Power Electronic Systems Elements - Solution Techniques for Time Domain Analysis - State Space Averaging - Hysteresis Band Control-Simulation Process - Mechanics of Simulation - Use of Simulation tools for Design and Analysis - Simulation of Power Electronic Circuits with PSIM, MATLAB.

Industry Applications: Engineering requirements- Control of power transmission and power quality- Power electronics for renewable energy sources and storage - Electrical transportation. **(9)**

TOTAL : 45

REFERENCES

1. *M.H.Rashid, "Power Electronics" 3rd Edition Prentice of Hall of India, New Delhi, 2014.*
2. *Mohan .N. Tore. M. Undeland, and William.P.Robbins, "Power Electronic Converters, Applications and Design", 3rd Edition John Wiley and Sons, New York, 2011.*
3. *Yuriy Rozanov, Sergey Ryvkin, Evgeny Chaplygin and Pavel Voronin "Power Electronics Basics-operating principles,design,formulas and applications" CRC Press, Taylor & Francis Group, 2015.*
4. *Andrej. M. Trzynadlowsk, "Introduction to Modern Power Electronics" , John Wiley and Sons, New York, 2011.*
5. *Jai. P. Agrawal, "Power Electronic Systems Theory and Design", Pearson Education, Asia, New Delhi, 2011.*
6. *Mohammed H.Rashid, "Power Electronics Hand Book", Elsevier- Academic Press, California, USA, III Edition, 2012.*
7. *Robert W. Erickson & Dragon Maksimovic "Fundamentals of Power Electronics" Second Edition, 2009 Springer science and Business media.*
8. *Haitham Abu-Rub,et al,"Power Electronics for Renewable Energy Systems, Transportation, and Industrial Applications" John Wiley & Sons Ltd, 2014.*

15MA15 - SMART SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

This course presents the fundamentals of modeling & analysis of smart systems. It is designed for engineering students who would like to have a broad understanding of current micro manufacturing processes in preparation to work directly or indirectly in this field.

COURSE OUTCOME

- CO1** : *The students have theoretical understanding of various physical phenomenon's behind the operation of different types of sensors and Microsystems*
- CO2** : *Students will gain an overview of the current state of smart sensors, to apply engineering skills to the analysis and design of Microsystems.*
- CO3** : *The emphasis on the integration of electronics with sensors to provide a smart system on chip with multiple integrated devices.*

MEMS DEVICES

Piezoresistive pressure sensor- Piezoresistive Accelerometer - Capacitive Sensing- Accelerometer and Microphone - Resonant Sensor and Vibratory Gyroscope - Low Power, Low Voltage Sensors- Micro Electro Mechanical Systems Analysis and Design of MEMS Devices- Nano Sensors. **(9)**

INTERFACING SENSOR INFORMATION AND MCU

Amplification and Signal Conditioning- Integrated Signal Conditioning- Digital conversion- MCU Control- MCUs for Sensor Interface- Techniques and System Considerations- Sensor Integration. **(9)**

COMMUNICATION FOR SMART SENSORS

Wireless Data Communications- RF Sensing- Telemetry- Automotive Protocols- Industrial Networks- Home Automation- MCU Protocols. **(9)**

PACKAGING, TESTING AND RELIABILITY IMPLICATIONS OF SMART SENSORS

Semiconductor Packaging- Hybrid Packaging- Packaging for Monolithic Sensors- Reliability Implications- Testing Smart Sensors- HVAC Sensor Chip. **(9)**

CONTROL AND IMPLICATIONS OF SMART SENSORS AND STANDARDS

Control Application using - CISC, RISC, DSP Control. Automated Remote Sensing - Process control over the Internet - Airplane Networks - Automotive Safety Network and IEEE 1451 Standards. **(9)**

TOTAL : 45

REFERENCES

1. Randy Frank, *"Understanding Smart Sensors"*, Artech House, Second Edition, 2011, Boston.
2. Minhang Bao, *"Analysis and design principles of MEMS devices"*, Elsevier Publications, 2005, USA.
3. Nadim Maluf and Kirt Williams, *"An Introduction to Micro Electro Mechanical Systems Engineering"*, Second Edition, Artech House Publishers, June 2004, USA.
4. Gabriel M. Rebeiz, *"RF MEMS: Theory, Design, and Technology"*, Wiley-Interscience; 1st edition, 2002, UK.
5. John A. Pelesko and David H. Bernstein, *"Modeling MEMS and NEMS"*, CRC Press, 2002, UK.
6. Rai-choudhury, *"MEMS and MOEMS Technology and Applications"*, PHI, 2010.
7. Ananthasuresh, *"Micro and Smart Systems"* Wiley Publishers, 2013.

15MA16 - EMBEDDED PROCESSORS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

Students can obtain a thorough understanding about the architecture and interfacing techniques of microcontroller.

COURSE OUTCOME

CO1 : *Students can interface peripheral devices with embedded processors.*

CO2 : *Students can choose appropriate microcontroller for the design specification with reference to a real time problem.*

CO3 : *Students can troubleshoot embedded based hardware devices*

LIST OF EXPERIMENTS

1. Interface matrix keyboard with microcontroller and display the key pressed on seven segment display
2. Program to read analog voltage applied at the input and display.
3. Program to generate a PWM waveform.
4. Interfacing LCD
5. Analog sensor Interfacing.
6. Serial communication
7. Motor Control Applications
8. Traffic Control System
9. Modeling Microwave Oven
10. PWM based motor Control

15MA21 - MODERN CONTROL THEORY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To make the students understand modelling, analysis, synthesis and design of control systems using advanced techniques.

COURSE OUTCOME

After completing this course the students will be able to

CO1 : Model and realize non linear systems using state space approach

CO2 : Analyze and synthesize complex control systems for controllability and observability

CO3 : Design optimal controller using various methods.

MODELING

Development of linear state-space models for nonlinear systems using Taylor series approach State diagram, state space and state-trajectory State-space realization of SISO systems using controllable, observable canonical forms (phase-variable approach) - Diagonal and Jordan's canonical forms - realization schematic Similarity transformation - transformation of a given system into different canonical forms.(9)

ANALYSIS

Solution of LTI state-equation - state-transition matrix - properties and computational techniques (Laplace transform technique and infinite series method). Eigen values - Eigen vectors - Diagonalization (diagonal and Jordan's forms using modal and Vander Monde matrix) - Computation of state transition matrix using diagonalization method. Caley-Hamilton Theorem - Concept of minimal polynomial - determination of state transition matrix using Sylvester interpolation formula. Controllability and Observability - Tests - Kalman's decomposition technique. (9)

SYNTHESIS

Introduction - relationship between pole location and system's dynamic performance - control specifications - choice of desired closed loop poles based on dominant pole pair approach from controller specifications - regulation and reference tracking problems. State feedback control design and Observer Design (direct substitution, using similarity transformation and Ackermann's formula)- Observer-based state-feedback control - separation principle - minimum order observer -Design of Servo systems - State-feedback control with integral error compensation. Introduction to Eigen structure assignment. (9)

STABILITY

Stability concepts - BIBO - Asymptotic stability - stability definitions in state space domain .stability theorems on local and global stability. Lyapunov stability analysis -Krasovskii Method. (9)

OPTIMAL CONTROL

Linear quadratic optimal regulator (LQR) problem formulation optimal - regulator design by parameter adjustment (Lyapunov method) - optimal regulator design by Continuous - time Algebraic Riccati Equation (CARE) . Optimal controller design using LQG framework. **(9)**

TOTAL : 45

REFERENCES

1. *K. Ogata, .Modern control engineering., 5th edition, Prentice Hall of India Pvt. Ltd., ND 2011*
2. *J. Nagrath and M. Gopal, "Control systems Engineering", 5th edition, New Age International Pvt Limited, New Delhi, 2012*
3. *Biswa Nath Datta,. Numerical methods for linear control systems. Elsevier, 2005*
4. *M. Gopal,. Digital Control and state variable methods., Tata McGraw Hill, New Delhi, 2012*

15MA22 - ROBOTICS TECHNOLOGY AND INTELLIGENCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce the fundamentals of robotics, analysis and control of industrial robots with intelligence.

COURSE OUTCOME

CO1 : *They will be able to work with variety of sensors in Robotic systems.*

CO2 : *They will be able to analyze the components of any Robotics system.*

CO3 : *They are able to study the applications of Robotics in industries.*

INTRODUCTION

Robotics - basic components - classification - specifications, Robotic sensors- proximity and range sensors, ultrasonic sensor, touch and slip sensor. Vision system - image processing and analysis - data reduction, segmentation, feature extraction and object recognition. Robotic drives and actuators - electric, hydraulic, pneumatic - selection. **(9)**

ROBOT END EFFECTORS AND TRAJECTORY PLANNING

End effectors - classification - mechanical, magnetic, vacuum and adhesive grippers. Gripper force analysis and gripper design. Work space analysis and motion analysis - pick and place operation, continuous path motion, interpolated motion, and straight line motion- manipulator kinematics - kinematic equation using homogeneous transformation and robot dynamics. **(9)**

ROBOT CONTROL

Control of robot manipulator - state equations - constant solutions - linear feedback systems, single-axis PID control - PD gravity control - computed torque control, variable structure control - impedance control. **(9)**

ROBOT INTELLIGENCE AND TASK PLANNING

Artificial Intelligence - techniques - state space - search problem reduction - predicate logic means and end analysis -problem solving - robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics. **(9)**

INDUSTRIAL ROBOTICS

Robot cell design and control - cell layouts - multiple robots and machine interference - work cell design - work cell control - interlocks - error deduction and recovery - work cell controller - robot cycle time analysis. Safety in robotics, Applications of robot and future scope. **(9)**

TOTAL : 45

REFERENCES

1. Fu, K.S., Gonzalez RC., and Lee C.S.G., "Robotics Control, Sensing Vision and Intelligence", McGraw Hill, 1987.
2. Robert J Schilling, "Fundamentals of Robotics: Analysis and Control", Prentice Hall of India, New Delhi, 2013.
3. Deb. S. R, "Robotics Technology and Flexible Machine Design", Tata McGraw Hill, 2010.
4. Mikell. P. Groover, Michell Weis, Roger. N. Nagel, Nicolous G. Odrey, "Industrial Robotics Technology, Programming and Applications ", McGraw Hill, Int 2012.
5. Richard D Klafter Thomas A.Chmielewski and Michael Negin, "Robotic Engineering: An Integrated approach", Prentice Hall of India, New Delhi, 2010.
6. Nagrath I.J., Mittal R.K., "Robotics and Control", Tata McGraw Hill, Sixth reprint, 2007.

15MA23 - EMBEDDED SYSTEM DESIGN USING FPGA

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

Students can understand the concepts of FPGA and the need for FPGA in embedded systems.

COURSE OUTCOME

CO1 : Students can learn the concepts of FPGA.

CO2 : Students can simulate and synthesis digital systems with Verilog coding.

CO3 : Students can implement embedded based applications using FPGA.

FPGA ARCHITECTURE AND OVERVIEW

Embedded system design flow - Robot Control System - Digital Design Platforms - Microprocessor-based Design - Single-chip Computer/Microcontroller-based Design -Application Specific Standard Products (ASSPs) - Design Using FPGA - robotic rover application - FPGA Devices - FPGA and CPLD - Architecture of a SPARTAN-3ETM FPGA - Floor Plan and Routing - Timing Model for a FPGA - FPGA Power Usage.

(9+6)

EMBEDDED SYSTEM DESIGN

FPGA-based Embedded Processor - Design Re-use Using On-chip Bus Interface - Creating a Customized Microcontroller - Robot Axis Position Control - FPGA-based Signal Interfacing and Conditioning - Motor Control Using FPGA- Case Studies for Motor Control -Prototype Using FPGA- FPGA Design Test Methodology.

(9+6)

VERILOG CONSTRUCTS

VLSI Design flow- behavioral style, the dataflow style, and structural style - Data types - Constants - Assignment Statement - Operators - Conditional Expressions - Statement types - Vector operations - Bit selects - Functions - Gate level modeling.

(9+6)

VERILOG MODELING COMBINATIONAL CIRCUITS

Combinational logic -Adders - Multiplexers - Decoders -Comparator -Parity Generators- ALU - Three state gate - UART model.

(9+6)

VERILOG MODELLING SEQUENTIAL CIRCUITS

Modelling Latches and Flip flops-- Sequential logic - Memory - Registers-Counters-Modeling FSM design- Synchronous and Asynchronous - Shift Register- Test bench verification.

(9+6)

TOTAL : 45 +30 = 75

REFERENCES

1. *Rahul Dubey, "Introduction to Embedded System Design Using Field Programmable Gate Arrays" Springer-Verlag London Limited, 2009*
2. *John F. Wakerly, Digital Design Principles and Practices", Pearson Education, Asia, III Edition, 2003.*
3. *Blaine Readler, "Verilog by Example: A Concise Introduction for FPGA Design", Full Arc Press,2011.*
4. *J. Bhasker, "A Verilog HDL Primer, Third Edition Hardcover", Star Galaxy Publishing; 3rd edition, 2005.*
5. *J.Bhasker, "Verilog HDL Synthesis, A Practical Primer", Star Galaxy Publishing; 3rd edition, 1998.*

15MA24 - ROBOTICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

Students can obtain a thorough understanding about of robotics, analysis and control of industrial robots with intelligence.

COURSE OUTCOME

CO1 : *They will be able to work with variety of sensors in Robotic systems.*

CO2 : *They will be able to analyze the components of any Robotics system.*

CO3 : *They are able to study the applications of Robotics in industries.*

LIST OF EXPERIMENTS

1. Obstacle avoidance
2. Pick and place
3. Object recognition
4. Computer control robot
5. Implementation algorithm for localization and planning using labview
6. Implementation algorithm for navigation using labview
7. Interfacing EVALBOT Robo Kit with Image Capturing devices.
8. Data acquisition and Control of EVALBOT Robo Kit.
9. Tilt angle Control.
10. Development of Control Algorithms for Automated Guided Vehicle.

**PROFESSIONAL ELECTIVES
INDUSTRIAL ENGINEERING**

15MAE01- ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To learn the concepts, coupling principles, control and measurement techniques involved in the field of Electromagnetic Interference and Compatibility.

COURSE OUTCOME

- CO1** : At the end of the course, student will acquire knowledge in the Real-world EMC design constraints and make appropriate tradeoffs to achieve the most cost-effective design that meets all requirements.
- CO2** : Student can able to design electronic systems and high speed Printed Circuit boards without errors or problems related to electromagnetic compatibility.
- CO3** : Student can understand the Measurement techniques for emission and about EMC standards.

EMI/EMC CONCEPTS

Concepts of EMI and EMC- Definitions and Units of parameters- Electromagnetic environment- Mechanisms of EMI generation - Practical experiences and concerns- Natural and Nuclear sources of EMI: Celestial Electromagnetic Noise, Lightning Discharge, Electrostatic Discharge, Electromagnetic Pulse-EMI from apparatus and circuits: Noise from Relays and Switches, Nonlinearities in circuits. (9)

EMI COUPLING PRINCIPLES

Conducted, radiated and transient coupling- Common ground impedance coupling - Common mode and ground loop coupling - Differential mode coupling - Near field cable to cable coupling - Field to cable coupling - Power mains and Power supply coupling-Cross talk in transmission lines-Transients in power supply lines. (9)

EMI CONTROL TECHNIQUES

Shielding- Filtering- Grounding- Electrical Bonding- EMI Suppression Cables- EMC connectors- Isolation transformer- Transient suppressors and Surge Suppression Devices. (9)

EMC DESIGN OF PCBs

Component selection and mounting; Choice of capacitors, inductors, transformers and resistors, PCB trace impedance- Routing-Cross talk control- Zoning- Grounding-VIAs connection- Terminations. (9)

EMI MEASUREMENTS AND STANDARDS

Open area test site Measurements-Measurement Precautions-Anechoic Chamber- TEM cell- Reverberating Chamber, GTEM cell- Comparison of test facilities- Civilian standards: CISPR, FCC, EN- Military standards: MIL 461/462. (9)

TOTAL : 45

REFERENCES

1. V.P.Kodali, "*Engineering EMC principles, Measurements and Technology*", IEEE Press, Newyork, 1996.
2. Henry W.Ott, "*Noise Reduction Techniques in Electronics System*", John Wiley and Sons, Newyork, 1998.
3. Bernhard Keiser, "*Principles of Electromagnetic Compatibility*", Artech house, 3rd Ed, 1994.
4. Clayton R. Paul, "*Introduction to Electromagnetic compatibility*", John Wiley & Sons, 1992.
5. Don R.J. White Consultant Incorporate, "*Handbook of EMI/EMC- Vol I-1985*", John Wiley and Sons, Newyork, 1988.

15MAE02 - AUTOMATION AND CONTROL OF INDUSTRIAL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective of this course is to acquaint students with sound knowledge base and skill sets to develop the necessities of industrial automation system design including automated process, assembly, their control and communication with the modern cutting edge innovative technologies through Career Focus Areas as required by the industries.

COURSE OUTCOME

At the end of the course the students will be able to:

- CO1** : *Get a vivid understanding of what all is required for industrial automation and its Components.*
- CO2** : *Understand control and industrial communication technologies, various inspection methods, analyze assembly and material handling systems.*
- CO3** : *Solve technical problems, be proficient in the analysis and to develop an innovative attitude for the industrial automation design, modeling, test by utilizing appropriate software and hardware tools and devices, to integrate various process in an industry.*

PRODUCTION AND AUTOMATION SYSTEM

Types of production - Functions- Automation in Production System-Principles and Strategies of Automation-Basic Elements of an Automated System- Advanced Automation Functions-Levels of Automations-Manufacturing Planning and Control-Production Economics: Methods of Evaluating Investment Alternatives-Costs in Manufacturing-Break-Even Analysis-Unit cost of production- Cost of Manufacturing Lead time and Work-in-process- Automated Flow lines - Analysis of Automated Flow Lines- material handling function- Automated Storage Systems- Product identification system: Barcode, RFID etc., - IoT in production. **(9)**

SENSORS, ACTUATORS AND CONTROL IN AUTOMATION

Industrial Control Systems-Sensors and Transducers- classification of sensors and transducers, signal processing and signal conditioning-Smart Sensors-MEMS.Motion Actuators- Types-Characteristics-Control of Actuators-PID Controller- Digital Controller- Process Industries Verses-Discrete-Manufacturing Industries-Continuous Verses Discrete Control- Computer Process Control and its Forms-Computer Based Industrial Control: Introduction & Automatic Process Control-LAN, Analog & Digital I/O Modules, SCADA System and RTU- Cyber security for Industrial Control Systems. **(9)**

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Relay logic- Block diagram of PLCs-hardware design - Logic Functions- Input & Output Modules- PLCs internal operation and signal processing -Programming of PLC Systems- Timer & Counter Instructions- Application to Robotics and FMS - PLC to factory automation - PLC in process control - PLC maintenance - internal PLC faults - faults external to PLC - programmed error - watch dogs - safety - hardware safety circuits - troubleshooting- Typical PLC Programming Exercises for Industrial Applications **(9)**

INDUSTRIAL COMMUNICATION SYSTEMS

Principles of interface, serial interface and its standards- parallel interfaces and buses- Characteristic features of industrial networks- Low level networks and their features-Field bus architecture- Use of field buses in industrial plants, functions, international standards, performance- HART network- PROFIBUS-PA: Basics, architecture, model, network design and system configuration. **(9)**

DISTRIBUTED CONTROL SYSTEMS AND APPLICATIONS

Functional Requirements, Configurations - some popular Distributed Control Systems Industrial Automation and Control Applications- Petroleum Refineries-Cement Plant - Thermal Power Plant - Pharmaceutical Industries - Steel plant- Water Treatment Plant-Automobile Industries-Smart Energy Management in Industries. **(9)**

TOTAL : 45

REFERENCES

1. *M.P.Grover, "Automation, Production Systems and Computer Integrated Manufacturing" Pearson Education Limited, New Delhi, 2015.*
2. *Krishna Kant, "Computer -Based Industrial Control", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.*
3. *Frank D.Petruzella, "Programmable Logic Controllers", second Edition, Mc Graw Hill, 2008.*
4. *John Park, and Steve MacKay "Practical Data Acquisition for Instrumentation and Control Systems" Newnes An imprint of Elsevier, Burlington, 2003.*
5. *John W.Webb and Ronald A. Resis, "Programmable Logic Controllers", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.*
6. *Richard.L.Shell, "Handbook of Industrial Automation" CRC Press, New York, 2009*
7. *Terry L. M. Bartelt, "Industrial Automated Systems Instrumentation and Motion Control" Cengage, Yes Dee Publishing Pvt Ltd, First Indian Reprint, 2014, Chennai.*
8. *K.L.Sharma, "Overview of Industrial Process Automation" Elsevier, 2011.*
9. *Tan Kok Kiong, Andi Sudjana Putra, "Drives and Control for Industrial Automation" Springer, 2010.*
10. *Clarence W. De Silva, "Sensors and actuators : Control System Instrumentation" CRC Press, 2007*
11. *Jose ´Cec?´lio, and Pedro Furtado, "Wireless Sensors in Industrial Time-Critical Environments" Springer International Publishing, Switzerland 2014.*
12. *Tyson Macaulay and Bryan Singer "Cybersecurity for Industrial Control Systems" CRC Press, 2011.*

POWER AND ENERGY

15MAE03 - DISTRIBUTED GENERATION AND SMART GRID

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Prerequisite : knowledge of power systems, microcontrollers, computer networks, computer programming

COURSE OBJECTIVE

This introductory course gives an insight of emerging concepts, technologies, applications and complex trade-off decisions related to the new intelligent energy grid that supports the green-energy initiatives.

COURSE OUTCOME

CO1 : To understand the concepts and technologies of various power generation schemes

CO2 : To design a suitable Microgrid

CO3 : Applying Internet of Things (IoT) to Microgrid environment

INTRODUCTION TO DISTRIBUTED POWER GENERATION

Distributed Generation Versus Traditional Power Systems - Working Principle: Thermal Plant - Hydro Plant - Nuclear Plant - Distributed versus Central Station Generation - Micro-Mini Hydel Plants - Micro-Mini Gas Turbine Powered Distributed Generators - Fuel Cells - Bio mass **(9)**

WIND ENERGY SYSTEMS

Principle of wind energy conversion - Nature of wind - Power in the wind - Site selection - Components of Wind Energy Conversion System (WECS) - Classification of WECS - Generating Systems - Synchronizing to the Grid - Generator Control - Load Control - Energy storage - Interconnected. **(9)**

SOLAR PV SYSTEMS

Solar PV Cell- Characteristics and Types - Arrays and Panels - Balance of Systems - DC Power Conditioning Converters - Maximum Power Point Tracking Algorithms - AC Power Conditioners - Synchronized operation with grid supply - Applications - Water pumping, street lighting - economic analysis of PV systems. **(9)**

SMART GRID MEASUREMENTS AND COMMUNICATIONS

Wide Area Measurement : Sensor Networks - Phasor Measurement Units - Communications Infrastructure - Fault Detection and Self-Healing Systems - Applications and Challenges

Smart Grid Communications: Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure - Home Area Networks (HAN) / Home Energy Networks (HEN) - Electric Vehicles and Vehicle-to-Grid Systems **(9)**

SMART GRID COMMERCIALISATION

Interoperability - Standards - Smart Grid Cyber Security - Metering Protocol - Substation Automation Protocol - Standards and Electricity Markets - Wheeling Prices **(9)**

TOTAL : 45

REFERENCES

1. James Momoh, *"Smart Grid : Fundamentals of Design and Analysis"*, Wiley -IEEE Press, 2012.
2. Krzysztof Inieewski, *"Smart Grid : Infrastructure and Networking"*, Tata McGraw Hill,2012
3. Math H.Bollen, Fainan Hassan, *"Integration of Distributed Generation in the Power system"*, Wiley - IEEE Press, 2011
4. Nur Asvik Hidayathullah, Akhtar kalam, *"State of the Art Distributed Generation & Smart Grid Technologies - A Review and and Analysis the Impacts of Distributed Generation (DG) on Smart Grid (SG) system"*, LAP LAMBERT academic publishing, 2012.

15MAE04 - ELECTRICAL ENERGY SYSTEMS DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To impart knowledge on design methodologies for integrated energy systems.

COURSE OUTCOME

CO1 : *To study the dynamics of a system.*

CO2 : *To understand the stability analysis of integrated system.*

CO3 : *To optimize energy management in hybrid systems.*

INTRODUCTION TO SYSTEMIC DESIGN AND INTEGRATION OF SYSTEMS

Energy systems: specific and shared properties - Energy and its properties - Entropy and quality of energy - Consequences for energy systems - Systemic design of energy systems - Electro-electrical conversion - Electromechanical conversion - Electrochemical conversion - Integration of Energetic Systems: - Control of an energetic system - Different approaches to the control of a system - Modeling and control of an energetic system - Example: control of a DC drive - Energetic Macroscopic Representation - Structure of control by inversion of an EMR - Example: control of an electrical vehicle - Example: control of a paper band winder/unwinder - Control design of electrical systems - The nominal control synthesis - analysis of robustness - Modeling and dynamical analysis of the nominal system. **(9)**

QUALITY AND STABILITY OF EMBEDDED POWER DC NETWORKS

Challenges to quality optimization - quality of the distributed energy - Combined and specialized electrical architectures - AC/DC converters - Simplified modeling of the HVDC network - Methods of causal analysis of AC/DC interactions - Characterization of the input impedances/admittances of equipment - Analytical characterization of the input impedance of systems in electrical engineering - Analysis of asymptotic stability based on impedance specifications - Principles: the case of a two-body cascading system - Analysis of asymptotic stability based on Routh-Hurwitz criterion - Analysis of network architectures with regard to their stability - dynamic behavior of an HVDC network subject to large-signal disturbances - Analysis tools for large signal stability. **(9)**

ENERGY MANAGEMENT IN HYBRID ELECTRICAL SYSTEMS WITH STORAGE

Introduction to energy hybridization - architectures of hybrid automobiles : - Parallel architecture: summation of the mechanical powers - Series architecture: summation of the electric powers - Series-parallel architecture - Energy management in electric junction hybrid systems with electric energy storage - Storage, essential properties, power invertibility, losses - Electric junction hybrid systems, electric node - Generic hybrid system with an electric node containing storage- Strategy for frequency splitting of power via active filtering - Electric node and energy degrees of freedom. **(9)**

ENERGY FLOW MANAGEMENT

Energy management in electric-junction multisource hybrid systems with storage: energy management strategy - Indicators, criteria and data for the design of hybrid systems - Properties of storage units for

hybridization - Mission properties, energy indicators - Examples simple hybridization: emergency generator for an aircraft based on a wind turbine hybridized by supercapacitors- emergency generator for an aircraft based on a fuel cell hybridized with supercapacitors - power train of a locomotive based on a combustion engine hybridized by batteries and supercapacitors - smoothing of photovoltaic generation via an electrolyzer-fuel cell tandem (H₂ /O₂ battery) and a lead acid battery. **(9)**

STOCHASTIC APPROACH APPLIED TO THE SIZING OF ENERGY CHAINS AND POWER SYSTEMS

Standard principle of the power report - Maximum current - Load factor - Diversity factor - Enhancement factor - Stochastic approach: - Principle - Modeling of the loads - types of loads - Modeling using a specification - Modeling using experimental readings - Simulation of the power flows - Analytical method - Monte Carlo method - Application to an "on-board" power system - Probabilistic and dynamic approach - Modeling of the loads and associated electrical quantities - Simulation of the power flows - Application to the embedded network **(9)**

TOTAL : 45

REFERENCES

1. *Xavier Roboam, "Systemic Design Methodologies for Electrical Energy Systems: Analysis, Synthesis and Management", John Wiley Systems, 2012*
2. *Xavier Roboam, "Integrated Design by Optimization of Electrical Energy Systems", ISTE and John Wiley & Sons, 2012.*
3. *Kim Younghyun, chang Naehyuck, " Design and Management and Energy Efficient Hybrid Electrical Energy Storage System ", Springer, 2014.*

15MAE05 - POWER QUALITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

This introductory course gives the broad overview of different power quality disturbances and its impact in electric power system.

COURSE OUTCOME

CO1 : *The students will have thorough understanding of the concept of utility distribution and industrial electric power quality phenomena.*

CO2 : *The students will be able to analyze power quality events.*

CO3 : *They will be able to design and evaluate the solutions to mitigate power quality disturbances.*

INTRODUCTION TO POWER QUALITY

Power Quality definition - Need for power quality - sensitive loads - Non linear loads - inter connected power systems - Deregulation - Power quality characteristics - types of power quality problems - Transients- Impulsive, Oscillatory - Voltage Variations-Short, Long Duration-Voltage Imbalance-Waveform Distortions: - DC Offset, Harmonics, Notching, Noise - Power Frequency Variations. Sources of power quality problems - Effects of power quality problems - Responsibilities of the suppliers and user of electrical power - power quality standards- Computer Business Equipment Manufacturers Associations (CBEMA) and ITIC curves- Cost of Poor Power Quality. **(7)**

TRANSIENTS

Definition - Power system transient model - Parameters-types - Causes of transients -Sources- Internal-Capacitor switching transients- Transients from load switching- External - Lightning transients - Effects of transients- Mitigation- Principles of Protection -Insulation Coordination - Devices for over voltage protection- Standards. **(8)**

SHORT AND LONG DURATION INTERRUPTIONS

Short duration interruptions - Definition - Magnitude, Duration - Causes of voltage sag, swell and interruption -Sources of voltage sag and short interruptions - Voltage during fault and post fault period, Current during fault period - Effects of voltage sag and short interruptions- Overview of mitigation methods(Qualitative treatment only)-Standards and voltage sag indices.

Long duration interruptions-Definition - Failure, Outage, Interruption - Origin of interruptions - Causes of long interruptions - Principles of regulating the voltage - Voltage regulating devices, Applications : Utility side, End-User side -Reliability evaluation - Cost of interruptions. **(12)**

HARMONICS AND GROUNDING

Harmonics-Description of the Phenomena -Parameters- Voltage Distortion - Current Distortion - Definitions and terms -Sources of Current and Voltage - Harmonics Sources - Effects of Harmonics- - Guidelines for harmonics voltage and current limitation- standards and measures IEEE and IEC standards.

Harmonic filters:Harmonic Distortion Evaluations-Devices for Controlling Harmonic Distortion
Passive, Active and hybrid filters (Qualitative treatment only)-Case Studies.

Grounding-Definitions and terms -Typical Earthing System- Reasons for grounding - National Electrical Code (NEC) grounding requirements - Utility Power system grounding - End-User power system grounding
- Typical Wiring and Grounding Problems-Solutions to Wiring and Grounding Problems. (11)

POWER QUALITY MONITORING AND SURVEY

Introduction - Power quality monitoring- Monitoring Considerations - Evolution of power quality monitoring
- Brief introduction to power quality measurement equipments - Planning, Conducting and Analyzing
power quality survey - Assessment of Power Quality Measurement Data - Utility-Customer interface-
Introduction to thermo graphy in power quality assessment-Industrial Case Studies-Power Quality
Monitoring Standards. (7)

TOTAL : 45

TEXT BOOKS

1. Roger.C. Dugan, Mark.F. McGranaghram, Surya santoso, H. Wayne Beaty, "Electrical Power Systems Quality", Tata McGraw Hill, 2012.
2. C.Sankaran, " Power Quality" CRC Press, 2011, New York

REFERENCES

1. Angelo Baggini, "Handbook of Power Quality" John Wiley & Sons, New York 2011.
2. Barry W. Kennedy, "Power Quality Primer" MC Graw Hill Publications, New York. 2006
3. M.H.J. Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", Wiley, 2011.
4. J.Arrillage, N.R.Watson And S.Chen, "Power System Quality Assessment", John Wiley&Sons,New York,2000.
5. Derek.A.Paice, "Power Electronic Converter Harmonics", IEEE Industrial Application Society, IEEE Press, New York 1996.
6. Short.T.A., "Distribution Reliability and Power Quality", CRC Press Taylor and Francis Group, 2006.

CONTROL AND AUTOMATION

15MAE06 - OPTIMAL CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce to the students the basic techniques of optimal control, static and dynamic optimization techniques and dynamic programming with the applications to practical examples.

COURSE OUTCOME

After completing this course the students will be able to

CO1 : Optimize the desired parameter using various methods

CO2 : Design optimal controller and solve linear regulator problem

CO3 : Apply mathematical programming of optimal control techniques to practical systems.

INTRODUCTION

Calculus of variation based techniques. Pontryagin's principle and control problems with constraints on control function. Dynamic programming. Numerical techniques. Optimal control of distributed parameter systems. **(9)**

STATIC AND DYNAMIC OPTIMIZATION

Parameter optimization. Calculus of Variations: problems of Lagrange. Mayer and Bolza. Euler-Lagrange equation and transversality conditions, Lagrange multipliers. **(9)**

PONTRYAGIN'S MAXIMUM PRINCIPLE

Pontryagin's maximum principle; theory; application to minimum time, energy and control effort problems, and terminal control problem. **(9)**

DYNAMIC PROGRAMMING

Belman's principle of optimality, multistage decision processes - application to optimal control. Linear regulator problem: matrix Riccati equation and its solution, tracking problem. **(9)**

APPLICATIONS

Computational methods in optimal control. Applications of mathematical programming. Singular perturbations - practical examples. **(9)**

TOTAL : 45

REFERENCES

1. M. Athans and P.L. Falb, *Optimal Control*, McGraw Hill, 2007.
2. S.P. Sethi and G.L. Thompson, *Optimal Control Theory*, 2nd edition, Kluwer Academic Publishers, 2000.

3. *D.P. Bertsekas, Dynamic Programming and Optimal Control, Volume II, 4th edition, Athena Scientific, 2012.*
4. *M. Green, D.E. Johnson and D.J. N. Limebeer, Linear Robust Control, Prentice Hall, Digitized Dec 2012.*
5. *Luigi Fortuna, Mattia Frasca, Optimal and Robust Control: Advanced Topics with MATLAB, CRC Press, 2012.*

15MAE07 - ROBUST CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To make the students the basic concepts of robust control techniques for multi-objective design, time varying and steady state solutions, Optimal State Estimation, Linear Matrix Inequalities.

COURSE OUTCOME

After completing this course the students will be able to

CO1 : Design robust controller for multi-objective using LMI based synthesis

CO2 : Find time varying and steady state solution for LQR controllers

CO3 : Synthesize controller by solving LMI problem for the given design specifications.

INTRODUCTION

Modern H_2 and H_∞ optimal controller design and to LMI-based synthesis techniques for such controllers and for multi-objective design. Optimal regulator problem with finite time horizon, Riccati differential equation. **(9)**

TIME-VARYING AND STEADY STATE SOLUTIONS

Algebraic Riccati equation, Hamiltonian system; Kalman's identity, phase margin of LQR controllers, spectral factorization. **(9)**

OPTIMAL STATE ESTIMATION

Kalman filter, LQG control, Generalized plant, review of LQG control; Signal and system norms, computing H_2 and H_∞ norms ; Singular value plots, input and output directions; Mixed sensitivity design, H_∞ loop shaping, choice of weighting filters; Case study: design example flight control. **(9)**

LINEAR MATRIX INEQUALITIES

Design specifications as LMI constraints (H_2 , H_∞ and pole region); Controller synthesis by solving LMI problems, multi-objective design. **(9)**

ROBUST CONTROL OF UNCERTAIN SYSTEMS

Small gain theorem, representation of parameter uncertainty; Balanced realization and model order reduction. **(9)**

TOTAL : 45

REFERENCES

1. K. Zhou, J. Doyle, and K. Glover, *Robust and Optimal Control*, Prentice-Hall, 2006.
2. K. Zhou and J. C. Doyle, *Essentials of Robust Control*, Prentice Hall, 2006.
3. Michael Green, David J. N. Limebeer, *Linear Robust Control*, 2012.
4. Andrzej Bartoszewicz, *Robust Control: Theory and Applications*, InTech, 2011.

15MAE08 - SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To make the students the basic concepts of adaptive control techniques, parameter estimation, identification of linear and non-linear systems.

COURSE OUTCOME

After completing this course the students will be able to

CO1 : model structures and predictors and perform convergence analysis

CO2 : identify linear and nonlinear dynamic systems

CO3 : design self tuning regulator using adaptive predictive control

INTRODUCTION

Overview of Systems Identification, Adaptive Control and applications. Parameter Estimation: Least Square, Generalized and Recursive Least Square, Estimator properties including error bounds and convergence, MES, ML and MAP estimators, Nonlinear Least Squares. **(9)**

MODEL STRUCTURES AND PREDICTORS

Recursive Identification of Linear dynamic systems: RLS, ELS, IV, RML, Stochastic Approximation, Extended Kalman Filter, generalized prediction error framework and its application to ARMA and state models, convergence analysis, Time varying parameters. **(9)**

NONLINEAR SYSTEM IDENTIFICATION

Adaptive schemes. Adaptive control theory and applications. Situations when constant gain feedback is insufficient. Robust control. The adaptive control problem. The model following problem. MRAS based on stability theory. Model following when the full state is measurable. Direct MRAS for general linear systems. Prior knowledge in MRAS. MRAS for partially known systems. Use of robust estimation methods in MRAS. **(9)**

SELF-TUNING REGULATORS

The basic idea of indirect self-tuning regulators. Direct Self-tuning regulators. Linear Quadratic STR. Adaptive Predictive control. Prior knowledge in STR. Linear-in the-parameters model. **(9)**

LEAST SQUARES ESTIMATION

Experimental conditions. Recursive estimators. Extended least squares. Robust estimation methods (dead zone, projection). Implementation issues. Nonlinear System Identification Techniques. **(9)**

TOTAL : 45

REFERENCES

1. *K.J. Astrom and B. Wittenmark, Adaptive Control, 2nd edition, Pearson 2013.*
2. *L. Ljung, System Identification Theory for the user, 2nd edition, Prentice-Hall, 2007.*
3. *K.S. Narendra and A.M. Annaswamy, Stable Adaptive Systems, Prentice-Hall, 2012.*
4. *Landau and Zito, Digital Control Systems: Design, Identification and Implementation, Springer, 2006.*
5. *Boutalis, Y., Theodoridis, D., Kottas, T., Christodoulou, M.A, System Identification and Adaptive Control Theory and Applications of the Neuro fuzzy and Fuzzy Cognitive Network Models, Springer, 2014.*
6. *Karel J. Keesman, System Identification: An Introduction, Springer, 2011.*

ELECTRONIC SYSTEM DESIGN

15MAE09 - ASIC AND FPGA DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To gain knowledge about partitioning, floor planning, placement and routing in ASIC and learn the architecture of different types of FPGA.
- To familiarize the different types of programming technologies and logic devices and to study the design flow of different types of ASIC with high performance algorithms.
- To understand the design issues of SOC and to analyse, synthesis, simulate and test systems.

COURSE OUTCOME

Students will be able to

CO1 : Design ASIC for a specific applications incorporating the partitioning and routing techniques.

CO2 : Implement a function based on certain application with FPGA.

CO3 : Implement SOC after simulation and testing.

OVERVIEW OF ASIC AND PLD

Types of ASICs - Design flow - CAD tools used in ASIC Design - Programming Technologies: Antifuse - static RAM - EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs - PLA -PAL. Gate Arrays - CPLDs and FPGAs. **(9)**

ASIC PHYSICAL DESIGN

System partition -partitioning - partitioning methods - interconnect delay models and measurement of delay - floor planning - placement - Routing : global routing - detailed routing - special routing - circuit extraction - DRC. **(9)**

LOGIC SYNTHESIS, SIMULATION AND TESTING

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation. **(9)**

FPGA

Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 - Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs. **(9)**

SOC DESIGN

Design Methodologies - Processes and Flows - Embedded software development for SOC - Techniques for SOC Testing - Configurable SOC - Hardware / Software co design.

Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB.

(9)

TOTAL : 45

REFERENCES

1. M.J.S .Smith, "*Application Specific Integrated Circuits*", Addison -Wesley Longman Inc., 1997.
2. S. Trimberger, "*Field Programmable Gate Array Technology*", Kluwer Academic Publications, 1994.
3. John V.Oldfield, Richard C Dore, "*Field Programmable Gate Arrays*", Wiley Publications 1995.
4. P.K.Chan & S. Mourad, "*Digital Design Using Field Programmable Gate Array*", Prentice Hall, 1994.
5. Parag.K.Lala, "*Digital System Design using Programmable Logic Devices*", BSP, 2003.
6. Farzad Nekoogar and Faranak Nekoogar, "*From ASICs to SOCs: A Practical Approach*", Prentice Hall PTR, 2003.
7. Wayne Wolf, "*FPGA-Based System Design*" Prentice Hall PTR, 2004.
8. R. Rajsuman, "*System-on-a-Chip Design and Test*", Artech House Publishers, 2000.
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10. Richard Munden, "*ASIC and FPGA Verification: A Guide to Component Modeling (Systems on Silicon)*", Morgan Kaufman Publishers, 2004.
11. Vikram Arkalgud Chandrasetty, "*VLSI Design: A Practical Guide for FPGA and ASIC Implementations*" Springer Science, 2004.

15MAE10 - SYNTHESIS AND OPTIMIZATION OF DIGITAL CIRCUITS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To understand the compilation techniques for hardware models , Architectural-level synthesis and optimization, including scheduling, resource sharing.
- To know the Logic-level synthesis and optimization techniques for combinational and synchronous sequential circuits.
- To gain a knowledge in Library binding algorithms

COURSE OUTCOME

The students can :

CO1 : Design a microelectronic circuit applying the suitable scheduling and resource sharing techniques.

CO2 : Implement a two, multiple level sequential logic circuit after optimization

CO3 : Implement circuit with specific cell libraries

CIRCUITS AND MODELS

Microelectronics-Microelectronic Design Styles-Design of Microelectronic Circuits-computer-Aided Synthesis and Optimization-Computer-Aided Simulation-Computer-Aided Verification Testing and Design for Testability-Graphs-Undirected Graphs-Directed Graphs-Perfect Graphs-Combinatorial Optimization-Decision and Optimization problems Algorithms-Tractable and Intractable Problems-Fundamental Algorithms-Graph Optimization Problems and Algorithms-The Shortest and Longest Path Problems-Vertex Cover-Graph Coloring-Clique Covering and Clique Partitioning. **(9)**

ARCHITECTURAL-LEVEL SYNTHESIS AND OPTIMIZATION

Hardware Modeling-Structural, Behavioral Hardware Languages, HDLs Used for Synthesis, Abstract Models Compilation and Behavioral Optimisation. Architectural Synthesis Problems: Area and Performance Estimation Strategies for Architectural Optimization Data-Path Synthesis-Control-Unit Synthesis - Synthesis of Pipelined Circuits. **(9)**

SCHEDULING ALGORITHMS

Scheduling without Resource Constraints- Scheduling with Resource Constraints-Scheduling Algorithms for Extended Sequencing Models-Scheduling Graphs with Alternative Paths-Scheduling Pipelined Circuits-Resource Sharing and Binding: Sharing and Binding for Resource-Dominated Circuits-Sharing and Binding for General Circuits Concurrent Binding and Scheduling-Resource Sharing and Binding for Non-Scheduled Sequencing Graphs-The Module Selection Problem-Resource Sharing and Binding for Pipelined Circuits-Sharing and Structural Testability. **(9)**

LOGIC-LEVEL SVNTHESIS AND OPTIMIZATION

Two-Level Combinational Logic Optimization: Logic Optimization Principles, Operations on Two-Level Logic Covers- Algorithms for Logic Minimization Symbolic Minimization and Encoding Problems-

Minimization of Boolean Relations Multiple-Level Combinational Logic Optimization: Models and Transformations for Combinational Networks-The Algebraic Model-Boolean Model-Synthesis of Testable Networks- Rule-Based Systems for Logic Optimization Sequential Logic Optimization: Sequential Circuit Optimization Using State-Based Models-Sequential Circuit Optimization Using Network Models-Implicit Finite-State Machine Traversal Methods. **(9)**

CELL-LIBRARY BINDING

Problem Formulation and Analysis-Algorithms for Library Binding-Covering Algorithms Based on Structural Matching- Covering Algorithms Based on Boolean Matching-Covering Algorithms and Polarity Assignment-Concurrent Logic Optimization and Library Binding-Testability Properties of Bound Networks-Specific Problems and Algorithms for Library Binding-Look-Up Table FPGA's-Anti-Fuse-Based FPGA's-Rule-Based Library Binding-Comparisons of Algorithmic and Rule-Based Library Binding-State of the Art and Future Trends: Synthesis Systems- Growth of Synthesis in the Near and Distant Future. **(9)**

TOTAL : 45

REFERENCES

1. *Giovanni De Micheli, "Synthesis and optimization of Digital Circuits", Tata McGraw-Hill, 2003.*
2. *John Paul Shen, Mikko H. Lipasti, "Modern processor Design", Tata McGraw Hill, 2003.*

15MAE11 - DIGITAL SYSTEM DESIGN AND TESTING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To realize and design hazard free circuits and to familiarize the practical issues of sequential circuit design.
- To gain knowledge about different fault diagnosis, testing methods and to estimate the performance of digital systems
- To analyze synchronous and asynchronous sequential circuits

COURSE OUTCOME

- CO1** : With the knowledge of state table and flow table students can design a synchronous and asynchronous sequential circuit after applying state and flow table minimization technique.
- CO2** : The students can diagnose a digital circuit for faults using suitable testing methods.
- CO3** : The students can design the digital system using VHDL

SEQUENTIAL CIRCUIT DESIGN

Analysis of clocked synchronous sequential circuits and modeling - State diagram, state table, state table assignment and reduction - design of synchronous sequential circuits - design of iterative circuits - ASM chart and realization using ASM. **(9)**

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

Analysis of asynchronous sequential circuit - flow table reduction - races - state assignment - transition table and problems in transition table - design of asynchronous sequential circuits - Static, dynamic and essential hazards - data synchronizers - mixed operating mode asynchronous circuits - designing vending machine controller. **(9)**

FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS

Fault table method - path sensitization method - Boolean difference method - D algorithm - Tolerance techniques - The compact algorithm - Fault in PLA - Test generation - DFT schemes - Built in self test. **(9)**

SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES

Programming logic device families - Designing a synchronous sequential circuit using PLA/PAL - Realization of finite state machine using PLD - FPGA - Xilinx FPGA-Xilinx 4000. **(9)**

SYSTEM DESIGN USING VHDL

VHDL operators - Arrays - concurrent and sequential statements - packages- Data flow - Behavioral - structural modeling - compilation and simulation of VHDL code - Test bench - Realization of combinational and sequential circuits using HDL - Registers - counters - sequential machine - serial adder - Multiplier-Divider - Design of simple microprocessor. **(9)**

TOTAL : 45

REFERENCES

1. Charles H.Roth Jr *"Fundamentals of Logic Design"* Thomson Learning 2004.
2. Nripendra N Biswas *"Logic Design Theory"* Prentice Hall of India, 2001.
3. Parag K.Lala *"Fault Tolerant and Fault Testable Hardware Design"* B S Publications, 2002.
4. Parag K.Lala *"Digital system Design using PLD"* B S Publications, 2003.
5. Charles H Roth Jr. *"Digital System Design using VHDL"* Thomson learning, 2004.
6. Douglas L.Perry *"VHDL programming by Example"* Tata McGraw Hill, 2006.

COMPUTER AND COMMUNICATION

15MAE12 - HIGH SPEED COMMUNICATION CIRCUITS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective is to study the design and working of circuits employed at various stages of high speed communication network along with a case study for a transceiver implementation.

COURSE OUTCOME

CO1 : At the end of the semester, the learner will understand working of RF communication circuits

CO2 : The student will be able to design circuits based on specifications.

CO3 : Students will compute the circuit elements required for a implementing a transceiver design.

INTRODUCTION

Introduction - Basic Concepts of RF Design -General Considerations - Effects of Nonlinearity - Noise - Passive Impedance Transformation - Scattering Parameters - Nonlinear Dynamic Systems (9)

TRANCEIVER AND AMPLIFIERS

Receiver Architecture - Types - Transmitter Architecture - Types - OOK Transceivers - Low Noise Amplifiers - LNA Topologies - Gain Switching - Band Switching - Non linearity calculations (9)

MIXERS

General Consideration - Passive - Gain - Noise - Input impedance - Active - Down conversion mixers - Gain - Noise - Linearity - up conversion mixers - Improved Mixer topologies - current Source Helpers - Enhanced Trans conductance - Low Flicker Noise - Performance Requirement - Topology (9)

SUBSYSTEMS

Oscillators -Cross coupled - Three point - LV VCOs and Wide Tuning Range - PLL - Type I, Type II - Frequency Synthesizers - Integer N - Settling Behavior - Spur reduction - PLL based Modulation- Divider Design (9)

IMPLEMENTAON

Transceiver Design Example - System Level Consideration - Receiver - Transmitter - Frequency Synthesizer - Frequency Planning - Receiver Design - LNA, Mixer, AGC - Transmitter Design - PA , Up converter - Synthesizer Design (9)

TOTAL : 45

REFERENCES

1. Behzad Razavi, "RF Microelectronics", Prentice Hall, Second Edition, 2012.
2. Thomas H. Lee "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2003.
3. Bosco H. Leung "VLSI for Wireless Communication", Pearson Education, 2002.
4. Behzad Razavi, " Design of Analog CMOS Integrated Circuit", McGraw Hill, 1999.

15MAE13 - HIGH PERFORMANCE COMPUTER ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective is to make the student understand and appreciate the fundamental issues and tradeoffs involved in the design of high performance computers.

COURSE OUTCOME

CO1 : The learner is exposed to the concepts of Pipelining and Parallelism

CO2 : The students learn the issues in memory organization and optimization methods.

CO3 : Students appreciate the need for Vector processing and RISC Architecture

PROCESSOR DATA PATH

Introduction - CPU Performance factors - Evaluating CPU Performance - Building a Datapath - Multicycle Implementation - Exceptions - Microprogramming (9)

PIPELINING

Overview of pipelining- Piplelined Datapath - Data Hazards - Forwarding - Branch Hazards - Dynamic Branch Prediction - Pipeline using HDL - Advanced Pipelining - Pentium 4 Pipeline. (9)

PARALLELISM

Classes of computers - Trends - Dependability-Quantitative principles - Instruction Level Parallelism - Reducing Branch Cost -Dynamic scheduling - Hardware based speculation - Advanced Speculation - Limitations of ILP for Realizable Processors. (9)

MEMORY HIERARCHY DESIGN

Basics of Cache -Measuring performance - Optimization of Cache performance - Virtual Memory - Page faults - TLB - Protection with virtual memory (9)

VECTOR PROCESSING AND RISC ARCHITECTURE

Vector Processor: Architecture - Issues - Effectiveness of Compiler Vectorization -Vector performance. RISC Architecture: Survey of RISC Architectures - SPARC, PA-RISC (9)

TOTAL : 45

REFERENCES

1. David A. Patterson, John J. Hennessy, "Computer Organization and Design - The Hardware / Software Interface", Third Edition, Morgan Kaufmann Publishers, 2005.
2. John J. Hennessy, David A. Patterson, "Computer Architecture - A Quantitative Approach", Fourth Edition, Morgan Kaufmann Publishers, 2006.
3. Carl Hamachar, Zvonco Vranesic and Safwat Zakv, "Computer Organization", McGraw Hill, 2002.
4. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", McGraw Hill International Edition, Singapore 2000.

15MAE14 - COMPUTER VISION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To develop the understanding of student on the issues involved in computer based perception methods and algorithms.

COURSE OUTCOME

CO1 : Student is provided with a review on image processing techniques for computer vision

CO2 : The learner understands the algorithms in 3D vision and motion analysis

CO3 : The student is enabled to apply of computer vision algorithms for real world applications.

IMAGE PROCESSING FOUNDATIONS

Review of image processing techniques - classical filtering operations - thresholding techniques - edge detection techniques - corner and interest point detection - mathematical morphology - texture **(9)**

SHAPES AND REGIONS

Binary shape analysis - connectedness - object labeling and counting - size filtering - distance functions - skeletons and thinning - deformable shape analysis - boundary tracking procedures - active contours - shape models and shape recognition - centroidal profiles - handling occlusion - boundary length measures - boundary descriptors - chain codes - Fourier descriptors - region descriptors - moments **(9)**

HOUGH TRANSFORM

Line detection - Hough Transform (HT) for line detection - foot-of-normal method - line localization - line fitting - RANSAC for straight line detection - HT based circular object detection - accurate center location - speed problem - ellipse detection - Case study: Human Iris location - hole detection - generalized Hough Transform - spatial matched filtering - GHT for ellipse detection - object location - GHT for feature collation **(9)**

3D VISION AND MOTION

Methods for 3D vision - projection schemes - shape from shading - photometric stereo - shape from texture - shape from focus - active range finding - surface representations - point-based representation - volumetric representations - 3D object recognition - 3D reconstruction - introduction to motion - triangulation - bundle adjustment - translational alignment - parametric motion - splinebased motion - optical flow - layered motion **(9)**

APPLICATIONS

Application: Photo album - Face detection - Face recognition - Eigen faces - Active appearance and 3D shape models of faces Application: Surveillance - foreground-background separation - particle filters - Chamfer matching, tracking, and occlusion - combining views from multiple cameras - human gait analysis Application: In-vehicle vision system: locating roadway - road markings - identifying road signs - locating pedestrians **(9)**

TOTAL : 45

REFERENCES

1. E. R. Davies, *"Computer & Machine Vision", Fourth Edition, Academic Press, 2012.*
2. R. Szeliski, *"Computer Vision: Algorithms and Applications", Springer 2011.*
3. Simon J. D. Prince, *"Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.*
4. Mark Nixon and Alberto S. Aquado, *"Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.*
5. D. L. Baggio et al., *"Mastering Open CV with Practical Computer Vision Projects", Packet Publishing, 2012.*
6. Jan Erik Solem, *"Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.*

15MAE15 - VISIBLE LIGHT COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To study the concepts of light theory, propagation of light, LEDs, optical detectors, optical receiver operation, and visible light communication

COURSE OUTCOME

CO1 : Ability to understand the principle of visible light communication

CO2 : Ability to use light as a medium for communication of data.

CO3 : Ability to understand the propagation of light waves , types of optical detectors and receivers , optical receiver operation.

LIGHT THEORY

The four important theories-the sources of light-properties of light-Refractive index-optical path-dispersion-the velocity of light-visible range-photons-dual nature (9)

PROPOGATION OF LIGHT WAVES

Introduction-Maxwell's equations-constitutive relations-Wave equation for free space- uniform plane waves-wave polarization-Energy density, the pointing vector and intensity-Radiation pressure and momentum-Light wave boundaries, wave incident normally at boundary, wave incident obliquely on boundary-Reflectance and transmittance-Brewster's law-Total internal reflection-Light propagating through a medium-Cauchy's dispersion formula-Dispersive power. (9)

OPTICAL DETECTORS AND OPTICAL SOURCES

Light emitting diodes-Physical principals of photodiodes-Photo detector noise-Detector response time-Avalanche multiplication noise-Structures for InGaAs APDs-Temperature effect on Avalanche gain-Comparison of photo detectors. (9)

OPTICAL RECIEVER OPERATION

Fundamental receiver operation-digital receiver performance-eye diagrams, Burst -mode receivers-analog receivers (9)

VISIBLE LIGHT COMMUNICATION

Worldwide VLC activities-Different technical aspects of VLC,Enhancing data transmission rate-Mitigation of optical background noises-Bidirectional transmission (9)

TOTAL : 45

REFERENCES

1. *Dr.N. Subramaniam Brijlal,Dr M.N Avandhanulu"A text book of optics" S.Chand & Company Ltd,2010*
2. *Gerd Keiser "Optical fiber communication" McGraw hill Education (India) Pvt Ltd,2013.*
3. *Cheng-Chung Lee "The current trends of photonics and optics" Springer Publications,2015.<http://www.springer.com/us/book/9789401793919>.*