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. Embedded and Real Time Systems

Curriculum and Syllabi

Under Choice Based Credit System

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

INDEX

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 ERTS programme will be able to fulfill all of the following PEO's for the curriculum :

1. The engineers of Embedded and Real Time Systems possess technical and professional knowledge to design and develop systems.
2. The engineers acquire skills to provide optimal solutions for the challenges in the industry.
3. The graduates practice high ethical and technical standards and contribute for the advancement of society through scientific research.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME OUTCOMES (POs)

POs	Graduate Attributes	Programme Outcome
PO1	Knowledge - Basics	An ability to apply concepts in engineering analysis and design.
PO2	Critical - Thinking	An ability to apply knowledge of electronics in a creative and innovative way to design, develop and produce useful products.
PO3	Problem - Solving	An ability to understand the impact of the engineering problems in global and societal context and provide solutions.
PO4	Research - Skill	To effectively write and present the research output in global scientific forums.
PO5	Usage of Modern tools	An ability to analyze systems with ICT.
PO6	Multidisciplinary	An ability to apply knowledge of real time systems in the diversified fields of engineering.
PO7	Project management	To demonstrate effective communication, leadership, and teamwork skills that contributes to the success of their organizations.
PO8	Continuous Learning	To exhibit a professional commitment, with continuous improvement and lifelong learning.
PO9	Ethical Practices and social responsibility	To develop solutions and make professional and ethical decisions with an understanding of the impact on societal, economic, global, and environmental issues.
PO10	Independent reflective learning	An ability to effectively communicate the analysis and design ideas to peers, clients and customers.
PO11	Collaborative work	An ability to converge technologies in an integrated manner to design and develop products.
PO12	Leadership Quality	An ability to acquire leadership qualities.

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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 : Embedded and Real Time Systems

Semester I

Course Code	Course Name	L	T	P	Credits	Type
15MA11	Linear Algebra and Stochastic Processes	4	0	0	4	FC
15MER12	Real Time Operating Systems	3	2	0	4	PC
15MA13	Embedded Processors	3	0	0	3	PC
15MER14	Mobile Communication	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
15MER21	Embedded Sensor Networks	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	P E
	Elective V	3	0	0	3	P E
	Elective VI	3	0	0	3	P E
	TOTAL				**9**	

Semester IV

Course Code	Course Name	L	T	P	Credits	Type
15MER41	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
		EMBEDDED CONTROL OF INDUSTRIAL SYSTEMS					
3	15MERE01	Intelligent Controllers for Power Quality Enhancement	3	0	0	3	PE
4	15MERE02	Embedded Control of Industrial Drives	3	0	0	3	PE
5	15MERE03	Design of Green Transportation System	3	0	0	3	PE
		ARCHITECTURE AND PROGRAMMING					
6	15MERE04	Modeling and Design of Embedded Systems	3	0	0	3	PE
7	15MERE05	Multicore Architecture	3	0	0	3	PE
8	15MERE06	System Simulation and Modeling	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 Assesment 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 : Embedded and Real Time Systems

Semester I

Course Code	Course Name	L	T	P	Credits	Type
15MA11	Linear Algebra and Stochastic Processes	4	0	0	4	FC
15MER12	Real Time Operating Systems	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
15MER21	Embedded Sensor Networks	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
15MER14	Mobile Communication	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
15MER41	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 the 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 in Game Theory - Non Linear Programming problems - Graphical Solution - Kuhn-Tucker conditions with non negative constraints. **(12)**

APPLIED PROBABILITY

Probability - Axioms - Conditional Probability - Baye's theorem - One and Two dimensional random variables - Expectation - Conditional expectation - Correlation - Probability Distributions - Binomial, Poisson ,Uniform, Exponential, Normal and Weibull 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 - Autocorrelation 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.*
2. *Kanti Swarup, 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.*

15MER12 - REAL TIME OPERATING SYSTEMS

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

To hone the students in problem solving and system design skills using modeling practices and learn key concepts in real time embedded application development using RTOS.

COURSE OUTCOME

CO1 : *The students can develop real time systems that are highly time bounded.*

CO2 : *The students can apply various real time algorithms in building embedded systems.*

CO3 : *The students can implement the RTOS development tools in building real time embedded systems.*

REAL TIME SYSTEMS

Introduction- Issues in real time computing- Structure of a real time system- Task classes- Performance measuresfor real time systems-Task assignment and scheduling algorithms - Mode changes- Fault tolerantscheduling - Real Time Models. **(9+6)**

μC/OS- II RTOS CONCEPTS

Foreground/Background process- Resources - Tasks - Multitasking -Priorities - Schedulers -Kernel - Exclusion- Inter task communication- Interrupts - Clock ticks - μC/OS- II Kernel structure - μC/OS- IIInitialisation - Starting μC/OS- II. **(9+6)**

μC/OS- II RTOS FUNCTIONS

Task Management - Time management - Semaphore management -Mutual exclusion semaphore - EventManagement -Message management - Memory management - Porting μC/OS- II - Comparison and Study ofVarious RTOS like QNX- VX Works-Psos. **(9+6)**

EMBEDDED LINUX

Embedded Linux - Features - Embedded Linux Distributions -Architecture of Embedded Linux - Linux KernelArchitecture - User Space -Root File System - Linux Start-Up Sequence - GNU Cross Platform Tool chain -Porting Traditional RTOS Applications to Linux. **(9+6)**

REAL-TIME LINUX

Linux and Real-Time - Real-Time Programming in Linux - Hard Real-Time Linux - Building and Debugging -Building the Kernel- Integrated Development Environment - Kernel Debuggers - Embedded Drivers - Boardsupport packages - Introduction to μClinux. **(9+6)**

TOTAL : 45 + 30 = 75

REFERENCES

1. *Krishna C.M., Kang G. Shin, "Real Time Systems", Tata McGraw-Hill Edition, 2010.*
2. *Philip A. Laplante, "Real Time Systems Design and Analysis-An Engineers Handbook", II Edition-IEEE Press, IEEE Computer Society Press, 2001.*
3. *Jean J Labrosse, "MicroC/OS-II The Real Time Kernel" II Edition, CMP Books, 2002.*
4. *P.Raghavan, Amol Lad, Sriram Neelakandan, "Embedded Linux System Design and Development", Auerbach Publications, Taylor& Francis Group, 2006.*
5. *Christopher Hallinan, "Embedded Linux Primer, A Practical, Real-World Approach", II Edition PearsonEducation, Inc., 2011.*

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.

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; ll edition 2000.*
6. *ARM Architecture Reference manual, ARM Limited.*
7. *Ajay V Desmukh, "Microcontrollers: Theory and Applications", Tata McGraw Hill, New Delhi, 2005.*

15MER14 - MOBILE COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To provide an understanding on wireless mobile communication, challenges in mobile environment and techniques developed to overcome the challenges.

COURSE OUTCOME

CO1 : *The student obtains a basic knowledge about various types of short and long range communication techniques.*

CO2 : *To enable the student to understand the functioning of cellular mobile systems.*

CO3 : *Student is introduced to modifications in traditional techniques to meet the need of high speed broadband connectivity.*

INTRODUCTION

Frequencies of radio transmission - Signals - Antennas - Signal propagation -Path-loss - multipath propagation - Multiplexing techniques - Modulation - ASK, FSK, PSK - Multicarrier modulation - Spread spectrum communication - Introduction to cellular systems. **(9)**

WIRELESS NETWORKS

Cellular wireless Networks - Principles - Analog - TDMA - CDMA- 3G networks - Cordless Systems - Wireless Local loop- WiMAX - Mobile IP - Wireless Application Protocol - WLAN - Wi Fi - IEEE 802.11standards - Blue tooth-UWB. **(9)**

CELLULAR MOBILE SYSTEMS

Spectrum Allocation - Trunking Efficiency - Basic Cellular System - Operation - Planning - Analog and Digital Cellular Systems - Frequency Reuse - Co-channel interference - Handoff mechanism - Cell splitting. **(9)**

MOBILE NETWORK LAYER

Mobile IP - Entities and Terminologies - Agent Discovery - Tunneling and Encapsulation - Optimizations - Dynamic host configuration protocol- Mobile Ad-hoc networks - Routing - Destination sequence distance vector - Dynamic source routing- Overview of ad-hoc routing protocols. **(9)**

MOBILE TRANSPORT LAYER

Traditional TCP - Congestion control - Slow start -Fast Re-transmit- Implications of mobility- Classical TCP improvements- Indirect TCP - snooping TCP -Mobile TCP -Transmission freezing -Selective retransmission -TCP over 2.5/3G wireless networks - Performance enhancing proxies. **(9)**

TOTAL : 45

REFERENCES

1. *Jochen Schiller "Mobile Communications", Second Edition, Addison-Wesley, Pearson Education, 2003*
2. *William Stallings, "Wireless Communications and Networks", Prentice Hall, Second Edition 2005*
3. *Andrea Goldsmith, " Wireless communication", Cambridge University Press, 2007*
4. *William C Y Lee , "Mobile Cellular Telecommunications - Analog and Digital Systems", Second Edition, McGraw Hill International Edition, 2006*
5. *Theodore S.Rappaport, "Wireless Communications Principles and Practice ", Second Edition, Pearson Education, Prentice Hall, 2002*
6. *Hansmann,"Principles of Mobile Computing", Wiley India, Second Edition, 2013.*

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, 2011Boston,*
2. *MinhangBao, "Analysis and design principles of MEMS devices", Elsevier Publications, 2005, USA.*
3. *NadimMaluf 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

15MER21 - EMBEDDED SENSOR NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce the basic concepts of Embedded Sensor Networks, the current, diverse research on sensor networks in a comprehensive manner and expose the fundamental issues in designing and analyzing sensor network information processing systems.

COURSE OUTCOME

CO1 : *The students will gain knowledge about information processing techniques with the architecture of different layers in a sensor network*

CO2 : *The communication subsystem, sensor tasking and control, and data management.*

CO3 : *Students will get knowledge about various platform to implement WSN.*

INTRODUCTION

Over view of sensor networks - Constraints and Challenges -Advantages of sensor networks - Sensor Network Applications - Collaborative Processing - Key definitions in sensor networks - Tracking scenario -Problem formulation -Sensing model-Collaborative Localization-Bayesian Estimation-Distributed representation and interference of states - Tracking multiple objects - State Space Decomposition-Data Association-Sensor models - performance comparison and metrics. **(9)**

NETWORKING SENSORS

Key assumptions - Medium access control - A survey of MAC protocols for WSN - S-MAC Protocol - IEEE 802.15.4 standard and Zig Bee -Energy efficient design of wireless sensor nodes - General Issues - Geographic, Energy-Aware Routing - Unicast Geographic Routing-Routing on a curve-Energy Minimizing Broadcast-Energy Aware Routing to a Region-Attribute based routing-Directed Diffusion-Rumor Routing-Geographic Hash table. **(9)**

INFRASTRUCTURE ESTABLISHMENT

Topology control - Clustering-Time synchronization - Clocks and Communication Delays-Interval Methods-Reference Broadcasts-Localization and Localization Services-Ranging Techniques-Range Based Localization Algorithms-Location Services-Task driven sensing- Role of sensor nodes and Utilities-Information based Sensor Tasking-Sensor Selection-IDSQ-Cluster leader based Protocol-Sensor tasking in tracking relations -Joint Routing and Information aggregation-Moving Centre of Aggregation-Multistep Information Aggregation-Multistep Information Directed Routing-Sensor Group Management. **(9)**

SENSOR NETWORK DATABASE

Sensor Database Challenges - Querying the physical environment -Query Interfaces-Cougar Sensor Database-Probabilistic Queries- In-network aggregation - Query Propagation and Aggregation-Tiny DB Query Processing-Query processing Scheduling and Optimization-Data centric storage - Data indices and range queries - Distributed Hierarchical aggregation -Multi resolution Summarization-Partitioning the

summaries-Fractional Cascading-Locality Preserving Hashing-Temporal data-Data Aging-Indexing Motion Data. **(9)**

SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware - Sensor network programming challenges -Node level software platforms-Operating system Tiny OS - Node level simulators - State centric programming- Applications - Core challenges - Research directions - Tiered architectures - Distributed signal processing - Monitoring and Debugging - Security and Privacy. **(9)**

TOTAL : 45

REFERENCES

1. *Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks An Information Processing Approach", Mogan Kaufmann Publishers,2004.*
2. *C.S. Raghavendra, Krishna M. Sivalingam and TaiebZnati, "Wireless Sensor Networks Springer Publishers, 2006.*

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. *DonR.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 student 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.*

EMBEDDED CONTROL OF INDUSTRIAL SYSTEMS

15MERE01 - INTELLIGENT CONTROLLERS FOR POWER QUALITY ENHANCEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective of this course is to provide with overall understanding of various power quality phenomenon, definitions, their origin, industrial survey, monitoring, international standards and mitigation methods. It also includes various compensation techniques and to develop intelligent controllers for power quality mitigations applicable to various custom power devices.

COURSE OUTCOME

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

CO1 : *Understand the real causes of the power quality; distinguish between various categories of power quality problems and their impacts on performance and their economics.*

CO2 : *Apply the knowledge of mathematics, and modern technological tools to solve the harmonics generation and other power quality issues in the power distribution networks and to develop an intelligent control algorithm for effective mitigation.*

CO3 : *Introduce to apply economical solution techniques for power quality migration, various compensation methods using dedicated embedded controllers.*

QUALITY OF POWER DELIVERY AND CONVENTIONAL MITIGATION METHODS

Electric Power Quality -State of the Art on Power Quality-Classification of Power Quality Problems- Causes of Power Quality Problems-Effects of Power Quality Problems on Users -Classification of Mitigation Techniques for Power Quality Problems- Equipments Used to Enhance Power Quality-Power Quality Standards-Power Quality Monitoring- Future Directions and Opportunities for Power Quality Enhancement: Power Quality Sensitivity - Utility Based Versus Customer Based Correction - Interconnection Standards - Power Quality Performance Requirements and Validation. **(8)**

SHUNT COMPENSATION

Passive and Active Shunt Compensation-Classification of Passive and Active Shunt Compensators-Principle of Operation and design of Passive Shunt Compensators-Introduction to Custom Power Devices - DSTATCOMs-Classification of DSTATCOMs- Generating Reference Currents Using Instantaneous PQ Theory- Principle of Operation, Control, design and analysis of DSTATCOMs-Development of embedded controller for DSTATCOM. **(9)**

SERIES COMPENSATION

Passive and Active Series Compensation - Classification of passive and Active Series Compensators - Principle of Operation and design of Passive Series Compensators - Dynamic Voltage Restorer(DVR)-Rectifier Supported DVR - DC Capacitor Supported DVR - DVR Structure: Output Feedback Control of DVR using embedded controller **(9)**

UNIFIED POWER QUALITY CONDITIONER

UPQC Configurations - Principle of Operation and Control of Unified Power Quality Compensators-Analysis and Design of Unified Power Quality Compensators - Modeling, Simulation, and Performance of UPQCs **(7)**

HARMONIC MITIGATION

Nonlinear Loads- Classification of Nonlinear Loads -Harmonic Propagation in the power systems and its effects- mitigation of harmonics- passive filters- limitations.

Active Power Filters- Shunt and Series Active Filters- Classification- Principle of Operation and Control of Shunt and Series Active Power Filters - Analysis and Design of shunt and Series Active Power Filters

Hybrid Power Filters- Classification of Hybrid Power Filters- Principle of Operation and Control of Hybrid Power Filters- Analysis and Design of Hybrid Power Filters - Development intelligent controller for active and hybrid power filters. **(12)**

TOTAL : 45

REFERENCES

1. *Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, "Power quality problems and mitigation techniques" John Wiley and Sons Ltd, 2015*
2. *ArindamGhosh and Gerard Ledwich "Power Quality Enhancement Using Custom Power Devices" Springer International Edition, 2011.*
3. *Math H. J. Bollen, "Understanding Power Quality Problems, Voltage Sags and Interruptions" Wiley India Pvt. Ltd.-new Delhi, 2011.*
4. *E. Acha, V.G.Agelidis, O.Anaya-Lara, T.J.E. Miller, "Power Electronic Control in Electrical Systems" Newnes an Imprint of Elsevier, 2006.*
5. *GrzegorzBenysek, "Improvement in the Quality of Delivery of Electrical Energy using Power Electronics Systems" Springer-Verlag London Limited 2007.*

15MERE02 - EMBEDDED CONTROL OF INDUSTRIAL DRIVES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To facilitate the students to understand the impact of electric drives with embedded systems in the control 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 : *Understand the models, new innovations required Electro-Mechanical systems via a roadmap-driven development process as required by modern industries.*

CO2 : *Improve the embedded software development skills required for industrial drive systems*

CO3 : *Develop an innovation attitude for the design, modeling, development industrial drives systems.*

INTRODUCTION

Electrical Drives - driving forces and evolving technologies-advantages and application range of electric drives- energy savings through drive system - elements of drive system - drive characteristics -load dynamics and steady state stability - multiquadrant operation - electric motors for drives - power electronic converters for drives - Modern trends in industrial drives and control - Motor Control Sensors-Evaluation of microcontrollers for motor control - Introduction to TMS 320 F 28335 Delfino digital signal controllers. **(9)**

DC MOTOR DRIVES

Introduction to DC-motor drives - speed control of DC motor drive with controlled rectifiers and choppers - speed control using inner current loop and outer speed loop - design of current loop with pole-zero cancellation - simulation of DC drives - Embedded controller based implementation of DC drives - converter structure - modes of operation - control variable algorithm - initialization of ADC/Timers/Interrupts - voltage/current sensing and comparison - PWM signal generation - Implementation of speed control algorithm using TMS 320F 28335 processor. **(9)**

INDUCTION MOTOR DRIVES

Induction Motor Drives: Reference frame theory - transformation of variables from stationary to arbitrary reference frame - PWM inverter fed induction motor drives - Vector control - open loop and closed loop PWM control - sensor less IM drives : a study - direct torque and flux control -space vector PWM control. Embedded controller based speed control implementation for IM drives: system components - sensors - controllers - current/speed measurements - scaling operation - control algorithm of speed measurement during high-speed/low speed regions - development of closed loop control block - Implementation of SVPWM technique with TMS 320F 28335 processor. **(9)**

SYNCHRONOUS MOTOR DRIVES

Open loop VSI fed drive and its characteristics - Self control - Torque control - Torque angle control - Power factor control - Brush less excitation systems - Starting methods - Field oriented control - Design of

closed loop operation of Synchronous motor drive systems. PM Synchronous Motor Drives: Types and torque developed in PMSM - Stationary and rotor reference frame modeling of PMSM - PMSM control system - Implementation of speed control algorithm using TMS 320F 28335 processor. **(9)**

SPECIAL MACHINES DRIVES

Switched Reluctance Motor drive: Fundamentals and control of SRM drives - open loop and closed control - closed loop torque and speed control - Implementation of speed control algorithm using TMS 320F28335 processor.

Brush less DC Motor Drives: Principals of operation - torque generation - open loop and closed control of BLDC drive - Implementation of speed control algorithm using TMS 320F28335 processor.

Stepper Motor Drives: Types and basic operation - stepper motor drive system - Implementation of control algorithm using MC68HC11E9 Microcontroller.

Introduction FPGA based implementation for Electric Drive Systems **(9)**

TOTAL : 45

REFERENCES

1. *Bose B K, "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt. Ltd, New Delhi, 2014.*
2. *Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 2008.*
3. *R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives" CRC Press, Taylor & Francis Group, 2010.*
4. *Richard Valentine, "Motor Control Electronics Handbook" McGraw Hill, New York, 2006.*
5. *Hamid A. Taliyat, Steven Campbell, "DSP-Based Electromechanical Motion Control", SRS Press, 2004*
6. *G.K. Dubey, "Power Semiconductor Controlled Drives" John Wiley and Sons, New York, 1999.*
7. *G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, edition, 2010.*
8. *VedamSubramaniam,"Electrical Drives and Applications", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.*
9. *Qian Cheng & Lei Yuan, "Vector Control of an Induction Motor based on a DSP", Master of Science Thesis, Chalmers University of Technology, Sweden, 2011.*
10. *Data Manual of "TMS320 F 28335 Digital Signal Controllers", released by Texas Instruments (2012) available in http:www/ti.com/DSC.*
11. *Bob King and Edgar Saenz, "Stepper Motor Control with an MC68 HC 11E9 Microcontroller", released by Free Scale Semiconductor document (AN 1285/D) available in http:www/freescale/AN1245/D.*
12. *M.N.Cirstea,et.al, "Neural and Fuzzy Logic Control of Drives and Power Systems" Newnes-An imprint of Elsevier Science, Oxford, 2012.*

15MERE03 - DESIGN OF GREEN TRANSPORTATION SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective of this course is to provide and develop a detailed description of green transportation engineering, sustainability assessment, environmental benefits, alternate fuel based vehicle design, economic aspects of electric vehicle, legislative compliances, performance analysis and real time safety issues.

COURSE OUTCOME

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

CO1 : *Understand the complexity of an automobile system as a whole unit and to define the functionalities of various components in electric/hybrid/plug-in hybrid vehicles.*

CO2 : *Introduce the components of elective vehicles such as electric motors, batteries and power converters and able to design their industrial models as a sub system of complete transportation.*

CO3 : *Design solar PV and fuel cell based electric vehicles according to the international standards and to perform various testing on the vehicle to serve up for the society and environment.*

INTRODUCTION

Introduction to alternate vehicles - limitations in conventional vehicles -need for electric vehicles - hybrid electric vehicles - plug-in hybrid electric vehicles - vehicle classification - vehicle dynamics -propulsion power - velocity and acceleration performance -Well to Tank (WTT) and Tank to Wheel (TTW) energy transport - tire-road force mechanics - EV/HEV/PHEV system architecture - power train configurations - sizing methodology of power train components -vehicle braking system - research challenges in electric vehicle - electric vehicle market analysis. **(9)**

COMPONENTS OF EV: ELECTRIC MOTORS, BATTERY AND POWER CONVERTERS

Electric motor drives: simple electric machines and drive components -DC drives- AC drives- permanent magnet machines for vehicular applications: PM synchronous motors - brushless DC motors - switched reluctance machines - multi quadrant operation.

Battery based energy storage: Introduction to battery - electrical and thermal parameters -types of battery- battery efficiency and capacity - electric circuit and empirical modeling of battery systems - charging and discharging performance - heavy duty traction batteries.

Power converters: DC-DC converters - non-isolated and isolated DC-DC converters - DC-AC converters - PWM control -Motoring and regenerative braking - design of closed loop control. **(12)**

SOLAR PV BASED EV DESIGN

Modeling of PV system - solar-sun related parameter estimation - irradiation measurement on moving vehicle - array temperature distribution - charge controllers - MPPT algorithm - up hill motoring operation - downhill regenerative operation - high efficiency micro controllers for power converters - closed loop motor control - design example of solar PV based electric vehicle. **(9)**

FUEL CELL BASED EV DESIGN

Introduction to fuel cell- basic fuel cell structure and characteristics - Fuel cell types and comparison - electric circuit model of fuel cell - conventional and advanced hydrogen storage system - fuel cell processing technology and transportation -fuel cell emission - Design example of fuel cell based electric vehicle: Selection of FC stack - FC controller - power converters - battery pack and motors - safety issues for hydrogen based electric vehicles. **(9)**

EV- PERFORMANCE AND SAFETY ISSUES

Electric vehicle verses IC engine vehicle comparison: efficiency comparison - pollution comparison - capital and operating cost comparison -GHG emission -emission standards and comparison - United Nations Framework Convention on Climate Change (UNFCCC) - Kyoto protocol -UNFCCC Paris climate change summit (COP 21) - legislation and standardizations for electric vehicles -EV performance testing -safety requirements of electric vehicles. **(7)**

TOTAL : 45

REFERENCES

1. *Ali Emadi, MehrdadEhsani, "Vehicular Electric Power Systems" Marcel Dekker, Inc., New York, 2014.*
2. *IqbalHussain, "Electric & Hybrid Vehicles - Design Fundamentals", Second Edition, CRC Press, 2011.*
3. *SandeepDhameja, "Electric Vehicle Battery Systems" Newnes, an imprint of Elsevier, 2013.*
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8. *Hybrid and electric vehicle solutions guide - released by Texas Instruments, 2011 available in www.ti.com/hev.*
9. *Indian vehicle emission standards: https://www.dieselnet.com/standards/in/2wheel.php*

ARCHITECTURE AND PROGRAMMING

15MERE04 - MODELLING AND DESIGN OF EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To understand the principal challenges in modelling and designing embedded systems stem from their interaction with physical processes.

COURSE OUTCOME

CO1 : *Students candesign embedded systems with understanding the joint dynamics of software, communication networks and physical processes*

CO2 : *Students can simulate and model the relationship embedded systems and its physical processes.*

CO3 : *Students can develop and implement embedded based applications.*

INTRODUCTION

Cyber Physical Systems as Embedded Systems - Applications-The Design Process - Modeling Dynamic behaviour - Continuous dynamics and discrete dynamics. **(9)**

STATE MACHINES

Composition of State Machines - Concurrent Composition- Hierarchical State Machines - Concurrent Models of Computation- Structure of Models- Synchronous-Reactive Models - Dataflow Models of Computation - Timed Models of Computation **(9)**

DESIGN OF EMBEDDED SYSTEMS

Embedded Processors - Types of Processors - Parallelism - Memory Architectures- Memory Hierarchy - Memory Models- Input and Output- I/O Hardware - Sequential Software in a Concurrent World- The Analog/Digital Interface **(8)**

ANALYSIS AND VERIFICATION

Invariants and Temporal Logic - Invariants - Linear Temporal Logic Equivalence and Refinement - Models as Specifications- Type Equivalence and Refinement - Language Equivalence and Containment- Simulation - Bisimulation - Reachability Analysis and Model Checking- Open and Closed Systems- Reachability Analysis- Abstraction in Model Checking -Model Checking Liveness Properties **(10)**

QUANTITATIVE ANALYSIS

Problems of Interest - Programs as Graphs- Factors Determining Execution Time - Basics of Execution Time Analysis - Other Quantitative Analysis Problems **(9)**

TOTAL : 45

REFERENCES

1. *E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems -A Cyber - Physical Systems Approach", I Edition (www. LeeSeshia.org), 2011.*
2. *Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Morgan Kaufman Publishers, 2004.*
3. *David E Simon, "An embedded software primer", Pearson education Asia, 2001.*

15MERE05 - MULTICORE ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To understand the concepts of parallel processing architectures and simultaneous execution of threads and processes.

COURSE OUTCOME

CO1 *: Students can understand the multicore within chip level design*

CO2 *: Students can develop a programming model for implementing multiprocessing environment.*

CO3 *: Students can learn various processors with multicore capabilities.*

SUPERSCALAR PROCESSORS

Fundamentals of Superscalar Processor Design, Introduction to Multicore Architecture - Chip Multiprocessing, homogeneous Vs heterogeneous design - SMP - Multicore Vs Multithreading. **(9)**

MEMORY ORGANIZATION

Shared memory architectures- synchronization - Memory organization -Cache Memory - Cache Coherency Protocols - Design of Levels of Caches. **(9)**

MULTICORE PROGRAMMING MODEL

Shared memory model - message passing model - transaction model - Open MP and MPI Programming. **(9)**

POWERPC ARCHITECTURE

RISC design - PowerPC ISA - PowerPC Memory Management - Power 5 Multicore architecture design, Power 6 Architecture. **(9)**

PROGRAMMING SUPPORT FOR MULTI-CORE/MANY-CORE PROCESSORS

Cell Broad band engine architecture, PPE (Power Processor Element), SPE (Synergistic processing element), Cell Software Development Kit, Programming for Multicore architecture. **(9)**

TOTAL : 45

REFERENCES

1. *Hennessey & Paterson, "Computer Architecture A Quantitative Approach", Harcourt Asia, Morgan Kaufmann, 1999.*
2. *Joseph JaJa, Introduction to Parallel Algorithms, Addison-Wesley, 1992.*

3. *IBM Journals for Power 5, Power 6 and Cell Broadband engine architecture.*
4. *Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability and Programmability" McGraw-Hill, 1993.*
5. *Richard Y. Kain, "Advanced Computer Architecture: A System Design Approach", PHI, 1999.*
6. *Rohit Chandra, Ramesh Menon, Leo Dagum, and David Kohr, Parallel Programming in Open MP, Morgan Kaufmann, 2000.*

15MERE06 - SYSTEM SIMULATION AND MODELING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To understand the concepts of simulation of a system and modelling to learn its behaviour.

COURSE OUTCOME

CO1 *: Students can understand the concepts in simulation*

CO2 *: Students can develop a model to represent the system and to test for functionality.*

CO3 *: Students can learn various methods to determine the performance of a system.*

SYSTEM AND SYSTEM ENVIRONMENT

Concept of a system-continuous and discrete systems - models of a system -modeling approaches - advantages and disadvantages of simulation systems-steps in simulation study-point estimates, confidence interval. **(9)**

PROBABILITY CONCEPTS IN SIMULATION

Random number generation-mid square-mid product method-constant multiplier method-additive congruential method-linear congruential method test for random numbers-the Chi square test - the Kolmogrov- Srimov test - Runs test-Gaps test-Random variable generation - Distribution - exponential, Poisson, Uniform, Weibull-Empirical distribution-Normal distribution - building on empirical distribution - rejection method. **(9)**

STATE SPACE BASED MODELS

Markovian-Non Markovian models - Discrete and Continuous time Markov Chains - Markov reward models - Semi Markov models - Markov regenerative models. **(9)**

PERFORMANCE MODELING

Performance models - queueing models - task precedence graphs - Dependability models - Reliability graphs - Fault trees. **(9)**

PETRI NET MODEL

Finite state Automata - Petri nets - Generalized Stochastic Petri nets - Stochastic Reward nets - Colored Petri nets - Fluid Petri nets. **(9)**

TOTAL : 45

REFERENCES

1. *Geoffrey Gordon,"Systems Simulation", 2nd Edition, Prentice Hall, India, 2002.*
2. *Kishore.S.Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", John Wiley and Sons, 2001.*
3. *Arson J.S., Banks J.C., and Nelson B.L., "Discrete Event Systems Simulation", Prentice Hall of India, 2004.*
4. *Kleinrock L., "Queueing Systems Theory",Vol.I, Kluwer Academic Press, 1995.*

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.*
9. *F. Nekoogar,"Timing Verification of Application-Specific Integrated Circuits (ASICs)."Prentice Hall PTR, 1999.*
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

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

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" BS 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)**

SUBSYTEMS

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)**

IMPLEMENTION

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 student learns 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)**

APPLICATION

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, receivers and 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)**

PROPOPGATION 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.NsubramaniyamBrijlal,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*