GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE-641 013

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

DURING 2016 ONWARDS

BRANCH: M.E. - APPLIED ELECTROICS - FULL TIME

SYLLABUS

VISION OF THE INSTITUTION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION OF THE INSTITUTION

- To achieve Academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

VISION OF THE DEPARTMENT

The vision of ECE department is to become pioneer in higher learning and research and to produce creative solution to societal needs.

MISSION OF THE DEPARTMENT

1. To provide excellence in education, research and public service.
2. To provide quality education and to make the students entrepreneur and employable.
3. Continuous upgradation of techniques for reaching heights of excellence in a global perspectives.

PROGRAM OUTCOMES

Ability to

1. Acquire in-depth knowledge in the field of Electronics with an ability to evaluate and analyse the existing knowledge for enhancement
2. Analyse critical complex engineering problems and provide solutions through research
3. Think laterally and solve engineering problems optimally after considering public health and safety, cultural and societal factors in the core areas

4. Extract information pertinent to challenging problems through literature survey and by applying appropriate research methodologies, techniques and tools to the development of technological knowledge
5. Select, learn and apply appropriate techniques, resources and modern engineering tools to complex engineering activities with an understanding of limitations
6. Understand group dynamics, recognise opportunities and contribute positively to multidisciplinary work to achieve common goals for further learning
7. Demonstrate engineering principles and apply the same to manage projects efficiently as a team after considering economical and financial factors
8. Communicate with engineering community and society regarding complex engineering activities effectively through reports, design documentation and presentations
9. Engage with commitment in life-long learning independently to improve knowledge and competence
10. Acquire professional and intellectual integrity, professional code and conduct, ethics of research and scholarship by considering the research outcomes to the community for sustainable development of society
11. Observe and examine critically the outcomes and make corrective measures, and learn from mistakes without depending on external feedback

PROGRAM EDUCATIONAL OBJECTIVES

1. Acquire indepth knowledge, analyse and solve complex problems through research in the field of electronics after considering public health, safety, cultural and societal needs
2. Apply the acquired research skills using modern tools and techniques to solve the challenging problems in multidisciplinary areas
3. Apply the learnt engineering principles for project and finance management and communicate with society effectively
4. Acquire professional and intellectual integrity, ethics of research for sustainable development of society through independent and lifelong learning

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR CANDIDATES ADMITTED DURING 2016 ONWARDS

BRANCH: M.E.(APPLIED ELECTROICS)-FULL TIME

M.E APPLIED ELECTRONICS 2016 REGULATION

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester I										
	Theory									
1	16AEFC01	Applied Mathematics	3	2	-	4	50	50	100	FC
2	16AEPC01	Advanced Digital System Design	3	0	-	3	50	50	100	PC
3	16AEPC02	Statistical Signal Processing	4	0	-	4	50	50	100	PC
4	16AEPC03	Embedded Controllers	3	0	-	3	50	50	100	PC
5		Professional Elective – I	3	0	-	3	50	50	100	PE
	Practical									
6	16AEPC04	Embedded System Design Laboratory	-	-	4	2	50	50	100	PC
Total Hrs			**16**	**2**	**4**	**19**	**300**	**300**	**600**	

***One Credit course**

16AEOC01-Seminar and Technical Writing

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester II										
	Theory									
1	16AEPC05	DSP Integrated Circuits	3	0	-	3	50	50	100	PC
2	16AEPC06	Analysis and Design of Analog Integrated Circuits	3	0	-	3	50	50	100	PC
3	16AEPC07	High Performance Computer Networks	3	0	-	3	50	50	100	PC
4	16AEPC08	VLSI Design Techniques	3	0	-	3	50	50	100	PC

5		Professional Elective - II	3	0	-	3	50	50	100	PE
6		Professional Elective - III	3	0	-	3	50	50	100	PE
	Practical									
7	16AEPC09	Signal and Image Processing Laboratory	-	-	4	2	50	50	100	PC
Total Hrs			**18**	**0**	**4**	**20**	**350**	**350**	**700**	

Code No	**Course Code**	**Course Name**	**Hours/ Week**				**Minimum Marks**			
			Lecture	**Tutorial**	**Practical**	**Credits**	**CA**	**FE**	**TOTAL**	**CAT**
Semester III										
	Theory									
1		Professional Elective - IV	3	0	-	3	50	50	100	PE
2		Professional Elective - V	3	0	-	3	50	50	100	PE
3		Professional Elective - VI	3	0	-	3	50	50	100	PE
	Practical									
4	16AEEE01	Project Phase-I	**-**	**-**	**12**	6	100	100	200	EEC
Total Hrs			**9**	**0**	**12**	**15**	250	250	500	

Code No	**Course Code**	**Course Name**	**Hours/ Week**				**Minimum Marks**			
			Lecture	**Tutorial**	**Practical**	**Credits**	**CA**	**FE**	**TOTAL**	**CAT**
Semester IV										
	Practical									
1	16AEEE02	Project Phase – II	**-**	**-**	**24**	12	200	200	400	EEC
Total Hrs			**0**	**0**	**24**	**12**	200	200	400	

CURRICULUM FOR CANDIDATES ADMITTED
DURING 2016 ONWARDS
BRANCH: M.E.(APPLIED ELECTROICS)-PART TIME

M.E APPLIED ELECTRONICS 2016 REGULATION

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester I										
	Theory									
1	16AEFC01	Applied Mathematics	3	2	-	4	50	50	100	FC
2	16AEPC01	Advanced Digital System Design	3	0	-	3	50	50	100	PC
3	16AEPC02	Statistical Signal Processing	4	0	-	4	50	50	100	PC
Total Hrs			**10**	**2**	**0**	**11**	**150**	**150**	**300**	

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester II										
	Theory									
1	16AEPC05	DSP Integrated Circuits	3	0	-	3	50	50	100	PC
2	16AEPC06	Analysis and Design of Analog Integrated Circuits	3	0	-	3	50	50	100	PC
3	16AEPC07	High Performance Computer Networks	3	0	-	3	50	50	100	PC
Total Hrs			**9**	**0**	**0**	**9**	**150**	**150**	**300**	

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester III										
	Theory									
1	16AEPC03	Embedded Controllers	3	0	-	3	50	50	100	PC
2		Professional Elective - I	3	0	-	3	50	50	100	PE
Practical										
3	16AEPC04	Embedded System Design Laboratory	-	-	4	2	50	50	100	PC
Total Hrs			**6**	**0**	**4**	**8**	150	150	300	

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester IV										
1	16AEPC08	VLSI Design Techniques	3	0	-	3	50	50	100	PC
2		Professional Elective - II	3	0	-	3	50	50	100	PE
3		Professional Elective - III	3	0	-	3	50	50	100	PE
Practical										
4	16AEPC09	Signal and Image Processing Laboratory	-	-	4	2	50	50	100	PC
Total Hrs			**9**	**0**	**4**	**11**	200	200	400	

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester V										
	Theory									
1		Professional Elective - IV	3	0	-	3	50	50	100	PE
2		Professional Elective - V	3	0	-	3	50	50	100	PE
3		Professional Elective - VI	3	0	-	3	50	50	100	PE
	Practical									
4	16AEEE01	Project Phase-I	**-**	**-**	**12**	6	100	100	200	EEC
Total Hrs			**9**	**0**	**12**	**15**	250	250	500	

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks			
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL	CAT
Semester VI										
	Practical									
1	16AEEE02	Project Phase - II	**-**	**-**	**24**	12	200	200	400	EEC
Total Hrs			**0**	**0**	**24**	**12**	200	200	400	

LIST OF PROFESSIONAL ELECTIVES

Code No	Course Code	Course Name	Hours/ Week				Minimum Marks		
			Lecture	Tutorial	Practical	Credits	CA	FE	TOTAL
1	16AEPE01	Image and Video Processing	3	0	-	3	50	50	100
2	16AEPE02	Mixed Signal Circuits and Interfacing	3	0	-	3	50	50	100
3	16AEPE03	RF System Design	3	0	-	3	50	50	100
4	16AEPE04	Microsensors and MEMS	3	0	-	3	50	50	100
5	16AEPE05	Graph Theory and Optimization Techniques	3	0	-	3	50	50	100
6	16AEPE06	Neural Networks	3	0	-	3	50	50	100
7	16AEPE07	Electronic Packaging Technologies	3	0	-	3	50	50	100
8	16AEPE08	Nano Electronics	3	0	-	3	50	50	100
9	16AEPE09	Real Time Operating System	3	0	-	3	50	50	100
10	16AEPE10	VLSI Signal Processing	3	0	-	3	50	50	100
11	16AEPE11	ASIC Design	3	0	-	3	50	50	100
12	16AEPE12	Electromagnetic Interference and Compatibility	3	0	-	3	50	50	100
13	16AEPE13	Solid State Device Modeling and Simulation	3	0	-	3	50	50	100

14	16AEPE14	Nonlinear Signal Processing	3	0	-	3	50	50	100
15	16AEPE15	MIMO Wireless Communication	3	0	-	3	50	50	100
16	16AEPE16	Multicore Architectures	3	0	-	3	50	50	100
17	16AEPE17	Bio telemetry and Telemedicine	3	0	-	3	50	50	100
18	16AEPE18	Satellite Image Analysis	3	0	-	3	50	50	100
19	16AEPE19	Digital Control Engineering	3	0	-	3	50	50	100
20	16AEPE20	Bio Medical Signal and Image processing.	3	0	-	3	50	50	100
21	16AEPE21	Ultrasonic Principles and Applications	3	0	-	3	50	50	100

CREDIT SUMMARY-Applied Electronics-FULL TIME

S.No.	Subject Area	Credits per Semester				Credits Total	% of Total Credits	Total No. of subjects
		I	II	III	IV			
1	FC	4	-	-	-	4	6	1
2	PC	12	14	-	-	26	39	9
3	PE	3	6	9	-	18	27	6
4	EEC	-	-	6	12	18	27	2
	TOTAL	19	20	15	12	66		

FC – Foundation Course

PC-Professional Core

PE-Professional Elective

EEC-Employment Enhancement Course

CREDIT SUMMARY-Applied Electronics-PART TIME

S.No.	Subject Area	Credits per Semester						Credits Total	% of Total Credits	Total No. of subjects
		I	II	III	IV	V	VI			
1	FC	4	-	-	-	-	-	4	6	1
2	PC	7	9	5	5	-	-	26	39	9
3	PE	-	-	3	6	9	-	18	27	6
4	EEC	-	-	-	-	6	12	18	27	2
	TOTAL	11	9	8	11	15	12	66		

FC – Foundation Course

PC-Professional Core

PE-Professional Elective

EEC-Employment Enhancement Course

APPLIED ELECTRONICS

DEPARTMENT OF ECE

16AEFC01 APPLIED MATHEMATICS	L	T	P	C
	3	2	0	4

CORE/ ELECTIVE COURSE**:** Core

PREREQUISITES:

- Basics of algebra, differential and integral formulae.

COURSE ASSESSMENT METHODS**:** Both continuous and semester-end assessment.

COURSE OBJECTIVES**:**

- To acquire knowledge of solving problems on matrix theory, discrete and continuous distributions.
- To develop an understanding of discrete and continuous random processes.
- To acquire knowledge of linear programming problems.
- To familiarize with queuing models.

COURSE OUTCOMES**:**

Upon completion of the course, the student will be able to:

CO1:Gain the skill of finding eigen values using QR algorithm and the knowledge of discrete andcontinuous distributions along with functions of random variables.

CO2:Develop discrete and continuous random processes including Markov processes and also solutionsof Linear Programming problems.

CO3:Understand probability values for various queuing models in situations of single or many service terminals available.

TOPICS COVERED**:**

LINEAR ALGEBRA (9)

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization - generalized eigenvectors – singular value decomposition and applications - pseudo inverse – least square approximations -Toeplitz matrices and some applications.

ONE DIMENSIONAL RANDOM VARIABLES (9)

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

RANDOM PROCESSES (9)

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process — Markov chain - Poisson process – Gaussian process.

LINEAR PROGRAMMING (9)

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment

Models.

QUEUEING MODELS **(9)**

Characteristic and representation of queuing models- Model I:[(M/M/1): ("/FIFO)], Model II: [(M/M/S):("/FIFO)],Model III:[(M/M/1): (N/FIFO)], Model IV: [(M/M/S):(N/FIFO)].

TOTAL:60PERIODS

Reference Books:

1. *Bronson, R.****Matrix Operation****,* ***Schaum's outline series****, McGraw Hill, New york (1989).*
2. *Oliver C. Ibe, "****Fundamentals of Applied Probability and Random Processes,*** *Academic Press, (An imprint of Elsevier), 2010.*
3. *Taha H.A. "****Operations Research: An introduction****" Ninth Edition, Pearson Education, Asia, New Delhi 2012.*
4. *Sankara Rao, K. "****Introduction to partial differential equations****" Prentice Hall of India, pvt, Ltd, New Delhi, 1997.*
5. *Andrews, L.C. and Philips. R. L. "****Mathematical Techniques for engineering and scientists****", Printice Hallof India, 2006.*
6. *O'Neil P.V. "****Advanced Engineering Mathematics****", (Thomson Asia pvt ltd, Singapore) 2007, cengage learning India private limited.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	1	2	-	-	-	1	-	-
CO2	-	3	-	1	-	-	-	-	1	-	-
CO3	1	-	-	1	2	-	-	-	1	-	-

APPLIED ELECTRONICS

16AEPC01 ADVANCED DIGITAL SYSTEM DESIGN	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

***CORE/ ELECTIVE COURSE*:** Core

PREREQUISITES:

- Digital Electronics, Programmable devices.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To get knowledge on Verilog HDL programming and ability to design digital systems.
- To design and analyze the clocked synchronous and asynchronous sequential Circuits.
- To get knowledge on Fault diagnosis and Testability algorithms.

***COURSE OUTCOMES*:**

Upon completion of the course, the students will have:

CO1 : Knowledge on Verilog HDL programming and ability to design digital systems.
CO2: Ability to design and analyze the clocked synchronous and asynchronous sequential Circuits.
CO3: Knowledge on Fault diagnosis and Testability algorithms.

***TOPICS COVERED*:**

SYSTEM DESIGN USING VERILOG HDL (9)

Hardware Modeling with Verilog HDL – Logic System, Data Types and Operators for Modeling in Verilog HDL - Behavioral Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines – Structural modeling – Compilation and Simulation of Verilog code –Test bench - Realization of combinational and sequential circuits using Verilog HDL.

SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9)

Analysis of clocked synchronous sequential circuits and modeling - State diagram, state table, state assignment and reduction - Design of synchronous sequential circuits - Design of Iterative circuits - ASM chart and realization using ASM.

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9)

Analysis of asynchronous sequential circuit – flow table reduction – Races - state assignment-transition table and problems in transition table- Design of asynchronous sequential circuit - Static, dynamic and essential Hazards – Data synchronizers – Mixed operating mode asynchronous circuits.

FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS (9)

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.

APPLIED ELECTRONICS

SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES (9)

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

TOTAL:45 PERIODS

Reference Books:

1.*Charles H.RothJr**"Fundamentals of Logic Design"** Thomson Learning 2004, 7th edition 2014.*

*2. Nripendra N Biswas **"Logic Design Theory"** Prentice Hall of India,2010.*

*3. Parag K. Lala**"Fault Tolerant and Fault Testable Hardware Design"** B SPublications,2002.*

*4. Parag K. Lala**"Digital system Design using PLD"** B S Publications,2003.*

*5. M.D.Ciletti ,**Modeling, Synthesis and Rapid Prototyping with the Verilog HDL**, Prentice Hall, 1999.*

*6. M.G. Arnold, **Verilog Digital – Computer Design**, Prentice Hall (PTR), 1999.*

*7. S. Palnitkar, **Verilog HDL – A Guide to Digital Design and Synthesis,**Pearson , 2003.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	3	2	2	1	2	2	-	-	1
CO2	2	1	1	2	2	-	2	2	-	-	1
CO3	1	1	1	2	3	-	3	1	-	-	1

APPLIED ELECTRONICS

16AEPC02 STATISTICAL SIGNAL PROCESSING	L	T	P	C
	4	0	0	4

CORE/ ELECTIVE COURSE: Core

PREREQUISITES:

- Digital signal processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To introduce the basics of random signal processing.
- To learn the concept of estimation and prediction theory.
- To know about adaptive filtering and its applications.
- To understand the basics of speech signal processing.

***COURSE OUTCOMES*:**

Upon completion of the course the students will be able to:

CO1: Basics of random signal processing and Estimation of the spectra of finite duration signal.

CO2: Designing different MMSE filters and model for prediction and Estimation.

CO3: Designing adaptive filters for different applications and analyzing different speech signal Processing technique.

***TOPICS COVERED*:**

INTRODUCTION TO RANDOM SIGNAL PROCESSING (9)

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Autocovariance, Autocorrelation, Parsevals theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

SPECTRAL ESTIMATION (9)

Estimation of spectra from finite duration signals, Nonparametric methods - Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric method, AR (p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

LINEAR ESTIMATION AND PREDICTION (9)

Linear Prediction of Signals-Forward and Backward Predictions, Solution to Prony's normal equation, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters. Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hopf Equation, FIR Wiener filter, Noise Cancellation, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Discrete Kalman filter.

ADAPTIVE FILTERS (9)

FIR adaptive filters – adaptive filter based on steepest descent method- Widrow-Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.

APPLIED ELECTRONICS

APPLICATION OVERVIEW-SPEECH PROCESSING (9)
Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Short-term Fourier transform (STFT): overview of Fourier representation, non-stationary signals, development of STFT, transform and filter-bank views of STFT; Short time Homomorphic Filtering of Speech; Linear Prediction (LP) analysis: Basis and development, Levinson-Durbins method, normalized error, LPC spectrum.
TOTAL: 60PERIODS

Reference Books:

1. *Monson H. Hayes, **"Statistical Digital Signal Processing and Modeling",** John Wiley and Sons, Inc, Singapore, 2002.*
2. *John G Proakis and Manolakis, "**Digital Signal Processing Principles, Algorithms and Applications**", Pearson Education, 4th Edition, 2009.*
3. *Lawrence Rabiner and Biing-Hwang Juang, "**Fundamentals of Speech Recognition"**, Pearson Education, 2003.*
4. *Dimitris G. Manolakis and Vinay K .Ingle ,**"Applied Digital Signal Processing"**, Cambridge University Press, 2011.*
5. *L.R. Rabiner and R.W. Schafer, "**Introduction to Digital Speech Processing"** (Foundations and Trends in Signal Processing), Now Publishers Inc.,USA, 2007.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	1	2	2	-	1	-	2	2	2
CO2	3	3	2	2	3	2	-	2	2	2	3
CO3	3	3	2	2	1	-	-	2	3	2	3

APPLIED ELECTRONICS

16AEPC03 EMBEDDED CONTROLLERS	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:**Core

PREREQUISITES:

- Microcontrollers

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To learn about the designing of an embedded system for commercial applications.
- To learn the features, architecture and programming of PIC microcontrollers.
- To learn the features, architecture and programming of MSP430 microcontrollers.
- Interfacing Input/output devices with the PIC and MSP430 microcontroller.

***COURSE OUTCOMES*:**

Upon completion of the course the students will be:

CO1: Ability to design and develop embedded systems for a given problem.

CO2:Ability to develop embedded system for entertainment, communication and Medical applications.

CO3: Ability to build and trouble shoot embedded systems.

TOPICS COVERED:

8-BIT CONTROLLER (9)

Microprocessors and microcontrollers, introducing PIC 16F877- architecture, memory technologies, timing circuits, power-up and reset, parallel ports, ADC, interrupt, serial peripheral buses (UART, I2C, SPI), PWM, counters and timers, instruction set and assembly language programming.

PIC DEVELOPMENT TOOLS AND PROGRAMMING (9)

Software development tools- editor, assembler, compiler, cross-compiler and simulator, Hardware development tools- development board, device programmer, in-circuit emulator and debuggers.
Embedded C Programming, data types and variables, data type modifiers, storage Class modifiers, C statements, structures and operations, pointers, libraries, in-line assembly programming, optimizing and testing embedded C programs.

PERIPHERAL INTERFACING WITH PIC MICROCONTROLLER (9)

Human and physical interfaces- switches to keyboard, LED display, liquid crystal display, Actuators and sensors, PWM, serial communication protocols (UART, I2C, SPI), programming interrupt, timers and counter.

16-BIT CONTROLLER (9)

MSP430 – Introduction to Architecture - Embedded C Programming in MSP430 – GPIO Pins & Configuration Timers, Capture, & PWM DAC- ADCs –Memory System-Flash Memory-DMA.

APPLIED ELECTRONICS

MSP 430 Interfacing **(9)**

USCI Port –SPI mode - I2C Mode-UART Mode & RS232 Low Power Mode Operation- Interfacing-Input Devices-Output Devices-DC Motor-Stepper Motor- Alarm interface- AC Devices.

TOTAL: 45 PERIODS

Reference Books:

1. *Kirk Zurell, **"C programming for Embedded Systems"**, CRC Press, 2000.*
2. *Dogan Ibrahim, **"Advanced PIC microcontroller projects in C"**, Newnes publication, 2012.*
3. *Tim Wilmshurst, **"Designing Embedded Systems with PIC microcontrollers-Principles andApplications"**, Newnes Publications, 2007.*
4. *Muhammad Ali Mazidi, RolinMcKinlay, Danny Causey, **"PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18"**, Prentice hall publications, 2007.*
5. *Martin Bates, "**Interfacing PIC microcontrollers-Embedded Design by Interactive Simulation"**,Newnes Publication, 2006.*
6. *John H. Davies**"MSP430 Microcontrollers Basics"**, Elsevier Limited 2008.*
7. *Steven Barrett, Daniel Pack ,**"MicrocontrollerProgramming and Interfacing TI MSP430, Part 1"**, Morgan and Claypool,2011.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	2	-	1	-	-	-	2	-	-
CO2	1	-	3	-	2	-	-	-	2	-	-
CO3	-	-	-	2	2	1	1	-	-	-	3

APPLIED ELECTRONICS

16AEPC04 EMBEDDED SYSTEM DESIGN LABORATORY	L	T	P	C
	0	0	4	2

***CORE/ ELECTIVE COURSE*:**

PREREQUISITES:

- Knowledge in Embedded Controllers and Embedded System.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To give a hands on programming experience using microcontrollers.
- To induce a programming skill in embedded system design using KEIL or RIDE software.

***COURSE OUTCOMES*:**

At the end of the course, the students will have:

CO1: Ability to gain the skill of effective design of embedded systems using Different microcontrollers.
CO2: Ability to use and interface PIC Microcontroller.
CO3: Ability to use and interface MSP430 Microcontroller.

TOPICS COVERED:

1. Programmes using PIC
2. microcontroller development Board.

2. Assembly and High level language programs for PIC - ports – timers -Seven Segment display – I^2C – LCD interface – Stepper Motor control.
3. RTOS – Simple task creation, Round Robin Scheduling, Pre-emptive scheduling, Semaphores, Mailboxes.
4. Assembly and High level language programs for MSP 430 - ports – timers - Seven Segment display – I^2C – LCD interface – Stepper Motor control.

TOTAL : 45 PERIODS

Reference Books:

1. *Kirk Zurell,* ***"C programming for Embedded Systems"****, CRC Press, 2000.*
2. *Dogan Ibrahim,* ***"Advanced PIC microcontroller projects in C"****, Newnes publication, 2012.*
3. *Muhammad Ali Mazidi, RolinMcKinlay, Danny Causey,* ***"PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18"****, Prentice hall publications, 2007.*
4. *Martin Bates,* ***"Interfacing PIC microcontrollers-Embedded Design by Interactive Simulation"****, Newnes Publication, 2006.*
5. *John H. Davies* ***"MSP430 Microcontrollers Basics"****, Elsevier Limited 2008.*
6. *Steven Barrett, Daniel Pack ,* ***"MicrocontrollerProgramming and Interfacing TI MSP430, Part 1"****, Morgan and Claypool,2011.*

APPLIED ELECTRONICS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	2	3	-	-	-	1	-	-
CO2	1	-	-	2	3	-	-	-	1	-	-
CO3	1	-	-	2	3	-	-	-	1	-	-

16AEPC05 DSP INTEGRATED CIRCUITS	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Core

PREREQUISITES:

- Digital Signal Processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To get basic knowledge of Digital Signal Processing, Discrete Time Transforms and VLSI circuit technologies.
- To get exposure to digital filters, multi rate signal processing and finite word length effects.
- To understand the principle of state of art DSP architectures and design of arithmetic units.

***COURSE OUTCOMES*:**

Upon completion of the course the students will have:

CO1: Basic knowledge of Digital Signal Processing, Discrete Time Transforms and VLSI circuit technologies

CO2: Exposure to digital filters, multi rate signal processing and finite word length effects

CO3: Understanding of the principle of state of art DSP architectures and design of arithmetic units

***TOPICS COVERED*:**

NUMBERS SYSTEMS, ARITHMATIC UNITS AND INTEGRATED CIRCUITS (9)

Conventional number system - Redundant Number system - Residue Number System .Bit-parallel and Bit-Serial arithmetic - Distributed Arithmetic - Basic shift accumulator - Reducing the memory size - Complex multipliers - Improved shift-Accumulator.

DIGITAL SIGNAL PROCESSING (9)

Digital signal processing - Sampling of analog signals - Selection of sample frequency - Signal-processsng systems - Frequency response - Transfer functions - Signal flow graphs - Filter structures - Adaptive DSP algorithms - FFT-The Fast Fourier Transform Algorithm - Image coding - Discrete cosine transforms.

DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS (9)

FIR filters - FIR filter structures - FIR chips - IIR filters - Specifications of IIR filters - Multirate systems - Interpolation with an integer factor L - Sampling rate change with a ratio L/M - Multirate filters. Finite word length effects -Parasitic oscillations - Scaling of signal levels - Round-off noise - Measuring round-off noise - Coefficient sensitivity - Sensitivity and noise.

DSP INTEGRATED CIRCUITS AND VLSI CIRCUIT TEHNOLOGIES (9)

Standard digital signal processors - Application specific IC's for DSP - DSP systems - DSP system design - Integrated circuit design. MOS transistor - MOS logic - VLSI process technologies - Trends in

CMOS technologies.

DSP ARCHITECTURES AND SYNTHESIS **(9)**

DSP system architectures - Standard and Ideal DSP architecture - Multiprocessors and multi computers - Systolic and Wave front arrays - Mapping of DSP algorithms onto hardware - Implementation based on complex PEs - Shared memory architecture with Bit – serial PEs - Layout of VLSI circuits - FFT processor - DCT processor and Interpolator as case studies.

TOTAL:45 PERIODS

Reference Books:

*1. Lars Wanhammer, **"DSP Integrated Circuits",** Academic press, New York 2001.*
*2.A.V.Oppenheim et.al, **"Discrete-time Signal Processing",** Pearson education, 2014.*
*3. Emmanuel C. Ifeachor, Barrie W. Jervis, **"Digital signal processing–A practical approach",** 2nd edition, Harlow, Prentice Hall, 2011.*
*4.Keshab K.Parhi, **„VLSI digital Signal Processing Systems design and Implementation",** John Wiley& Sons, 2007.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	2	2	-	-	-	-	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-
CO3	3	2	-	2	3	-	-	-	-	-	-

APPLIED ELECTRONICS

16AEPC06 ANALYSIS AND DESIGN OF ANALOG INTEGRATED CIRCUITS	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Core

PREREQUISITES:

- Analog integrated circuits.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To acquire knowledge on circuit configuration for linear integrated circuits and multiple transistor amplifier.
- To analyze nonlinear analog circuits.
- To analyze and design Operational amplifier.

***COURSE OUTCOMES*:**

Upon completion of this course the students will have:

CO1: Knowledge on circuit configuration for linear integrated circuits and multiple transistor amplifiers.
CO2: Ability to analyze nonlinear analog circuits.
CO3: Ability to analyze and design Operational amplifier.

***TOPICS COVERED*:**

CIRCUIT CONFIGURATION FOR LINEAR IC (9)

Current Sources-General Properties-Simple Current Mirror with beta helper-Simple current mirror with degeneration-Cascode Current Mirror-Wilson Current MIRROR- Widlar current source-Supply Insensitive Biasing-Temperature Insensitive Biasing. Output Stages - Emitter and source followers, Push pull output stages.

SINGLE TRANSISTOR AND MULTIPLE TRANSISTOR AMPLIFIER (9)

Basic single transistor amplifier stages -CE, CB, CC configuration- Multiple transistor amplifier stage – active cascode configuration, differential pairs – Emitter coupled pair.

OPERATIONAL AMPLIFIER (9)

Analysis of operational amplifier circuit, Slew rate model and High Frequency Analysis - Operational Amplifier noise.

NON LINEAR ANALOG CIRCUITS (9)

Precision Rectification-Analysis of four quadrant and variable trans conductance multiplier-Application of Gilbert cell. Balanced Modulator - Closed loop analysis of PLL - Voltage Controlled Oscillator.

ANALOG DESIGN WITH MOS TECHNOLOGY (9)

MOS Current Mirror-Simple, Cascode, Widlar and Wilson Current source-MOS Supply Insensitive Biasing. MOS amplifier, source coupled pair and basic two stage MOS opamps.

TOTAL:45 PERIODS

APPLIED ELECTRONICS

Reference Books:

1.Gray Mayer,Lewis Hurst, ***"Analysis and Design of analodg ICs",****5th edition, Wiley International,2009.*
*2. Grebene, "****Bipolar and MOS Analog Integrated Circuits design****",John Wiley and sons Inc 2003.*
*3. Rowbik Gregorian and Gabor C.Temes, "****Analog Integrated Circuits for Signal Processing****", John Wiley International 1986.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	2	-	1	2	1	-
CO2	3	2	2	2	2	2	-	1	2	1	-
CO3	3	2	2	2	2	2	-	1	2	1	-

16AEPC07 HIGH PERFORMANCE COMPUTER NETWORKS	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Core

PREREQUISITES:
- Knowledge in Computer Networks.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**
- To ensure a comprehensive understanding of high speed computer network architectures.
- To study mathematical models related to network performance analysis.
- To focus on current and emerging networking Technologies.

***COURSE OUTCOMES*:**
Upon completion of this course the students will have ability:

CO1: To analyze the real time engineering problems and to find the suitable network protocols.
CO2: To analyze performance of network related issues using mathematical models.
CO3: To compare the various methods of providing connection-oriented services over an advanced network with reference to MPLS, VPN.

***TOPICS COVERED*:**

SWITCHING NETWORKS (9)

Switching – Packet switching - Ethernet, Token Ring, FDDI, DQDB, Frame Relay, SMDS, Circuit Switched – SONET, DWDM, DSL, Intelligent Networks – CATV, ATM – Features, Addressing Signaling & Routing, Header Structure, ATM Adaptation layer, Management control, BISDN, Internetworking with ATM.

MULTIMEDIA NETWORKING APPLICATIONS (9)

Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP- differentiated services.

ADVANCED NETWORKS CONCEPTS (9)

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS-operation, Routing, Tunneling and use of FEC, Traffic Engineering, and MPLS based VPN, overlay networks-P2P connections.-IPv4 vs. V6.

PACKET QUEUES AND DELAY ANALYSIS (9)

Littles theorem, Birth and Death process, queueing discipline- Control & stability -, Markovian FIFO queueing system, Non-markovian - Pollaczek-Khinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues – Burke"s theorem and Jackson Theorem.

NETWORK SECURITY AND MANAGEMENT (9)

Principles of cryptography – Elliptic-AES- Authentication – integrity – key distribution and certification – Access control and: fire walls – DoS-attacks and counter measures – security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1.

TOTAL: 45 PERIODS

Reference Books:

1. *Aunurag Kumar, D. Manjunath, Joy Kuri,* ***"Communication Networking"****, Morgan KaufmannPublishers, 2011.*
2. *J.F. Kurose & K.W. Ross,* ***"Computer Networking- A Top Down Approach Featuring the Internet****",Pearson Education, 2nd Edition, 2003.*
3. *Nader F.Mir,* ***"Computer and Communication Networks"****, Pearson Education, 2009.*
4. *Walrand .J. Varatya,* ***"High Performance Communication Network"****, Morgan Kaufmann HarcourtAsia Pvt. Ltd., 2nd Edition, 2000.*
5. *HersentGurle& Petit,* ***"IP Telephony, Packet Pored Multimedia Communication Systems",*** *Pearson Education 2003.*
6. *Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition,Pearson Education, 2012.*
7. *Larry L.Peterson& Bruce S.David, "Computer Networks: A System Approach"- Morgan Kaufmann Publisher, 1996.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	3	-	-	1	-	-	2	-	-
CO2	1	-	-	-	3	-	-	-	2	-	-
CO3	-	-	-	2	-	-	-	1	1	-	-

APPLIED ELECTRONICS

16AEPC08 VLSI DESIGN TECHNIQUES	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*: ** Core

PREREQUISITES:

- Basics of Digital System Design.

***COURSE ASSESSMENT METHODS*: ** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To understand MOS transistor theory, technology and circuit characterization.
- To gain knowledge on combinational and sequential circuit design.
- Todesign VLSI subsystem components with test circuits.

***COURSE OUTCOMES*:**

Upon completion of this course the students will have an ability:

CO1:Tounderstand MOS transistor theory, technology and circuit characterization.

CO2:Togain knowledge on combinational and sequential circuit design.

CO3:Todesign VLSI subsystem components with test circuits.

***TOPICS COVERED*:**

MOS TRANSISTOR THEORY (9)

VLSI Design Flow- MOS Transistors, CMOS Logic - Ideal I-V Characteristics - Nonideal I-V Effects, DC Transfer Characteristics.

MOS TECHNOLOGY AND CIRCUIT CHARACTERIZATION (9)

nMOS Fabrication - CMOS Fabrication, BiCMOS Technology, Layout Design Rules, Latch up in CMOS circuits, CMOS Process Enhancements, Technology Related CAD Issues -Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Interconnect, switching characteristics.

LOGIC CIRCUIT DESIGN (9)

Combinational circuit design: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Circuits, Sense-amplifier Circuits, BiCMOS Circuits, Low-power Logic Design.**Sequential circuit design:** CMOS circuit design Latches and Flip flops, Two-phase timing types, Synchronizers.

VLSI SUBSYSTEM COMPONENTS (9)

Addition/Subtraction, Comparators, Counters, Coding, Boolean Logical Operations, Shifters, Multiplication, Division, SRAM, ROM, Serial Access Memories, Content-Addressable Memory, Power distribution, Input/Output, Clock distribution.

TESTING AND VERIFICATION **(9)**

Logic verification, Manufacturing tests, Test fixtures and test programs, Logic verification principles, Manufacturing test principles, Design for testability, Boundary scan.

Total: 45 PERIODS

Reference books:

1.Neil H.E. Weste, David Harris &Ayan Banerjee, ***"Principles of CMOS VLSI Design: A System Perspective",*** *Second Edition, Pearson Education Pvt. Ltd. 2013.*
2.Douglas A. Pucknell& K. Eshraghian, ***"Basic VLSI Design",*** *(3/e), Third Edition, PHI, 2011.*
*3.John P.Uyemura****"Introduction to VLSI Circuits and Systems",*** *John Wiley & Sons, Inc., 2002.*
4.Eugene D.Fabricius, **Introduction to VLSI Design***McGraw Hill International Editions, 1990.*
5.Wayne Wolf, ***"Modern VLSI Design System on chip****. Pearson Education, 2002.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	3	1	1	-	1	1	1	1
CO2	3	3	3	2	1	-	1	-	1	-	1
CO3	3	2	3	2	2	1	2	-	-	-	1

APPLIED ELECTRONICS

16AEPC09 SIGNAL AND IMAGE PROCESSING LABORATORY	L 0	T 0	P 4	C 2

***CORE/ ELECTIVE COURSE*:**Core

PREREQUISITES:

- Digital signal processing.
- Digital image processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To Pre-Process a given Image.
- To analyse a given Image.
- To estimate a given non-stationary signal using Parametric and Non-Parametric methods.

***COURSE OUTCOMES*:**

Upon completion of this course the students will have:

CO1 :Ability to Pre-Process a given Image.
CO2 :Ability to analyse a given Image.
CO3 : Ability to estimate a given non-stationary signal using Parametric and Non-Parametric methods.

***TOPICS COVERED*:**

1. Perform image Smoothing and Sharpening of an eight bit colour image.
2. Implement a MATLAB function for (a) Edge Detection (b) Line Detection (c) Boundary Extraction Algorithm.
3. Implement a MATLAB function for Arithmetic Mean &Geometric Mean Filter.
4. Implement the spatial image enhancement functions on a bitmap image –Enlargement.
5. Advanced Image segmentation.
6. Image Restoration.
7. Image morphology to analyze shape details of image structures.
8. Generation of Various Signals and finding its FFT.
9. Estimate PSD using Periodogram and Modified Periodogram methods.
10. Estimation of Power Spectrum using Bartlett and Welch methods.
11. Parametric methods of Power Spectrum Estimation.
12. Design of LPC filter using Levinson-Durbin Algorithm.
13. Study Finite Length Effects using Simulink.
14. Adaptive Noise Cancellation using Simulink.
15. Design and Simulation of Notch Filter to remove 60Hz Hum/noise of given Signal (Speech/ECG).

TOTAL:45PERIODS

Reference Books:

1.Monson H. Hayes. ***"Statistical Digital Signal Processing and Modeling",*** *John Wiley and Sons, Inc, Singapore 2002.*
*2.Rafael C. Gonzalez, Richard E Woods, Steven Eddins, "****Digital Image Processing using MATLAB****", Pearson Education, Inc., 2004.*
3.www.mathworks.com.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	2	1	1	1	-	-	-	-	-	-
CO2	2	1	1	2	1	-	-	1	1	-	-
CO3	3	1	1	-	1	-	-	1	1	-	-

APPLIED ELECTRONICS

16AEPE01 IMAGE AND VIDEO PROCESSING (Common to VLSI design)	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Digital Signal Processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To gain knowledge on the basics of digital imaging.
- To get exposure to various image processing techniques.
- To get exposure to video processing.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO1: Knowledge on the basics of digital imaging.
CO2: Exposure to various image processing techniques.
CO3: Exposure to video processing.

***TOPICS COVERED*:**

DIGITAL IMAGE PROCESSING FUNDAMENTALS (9)

Image Processing Systems- Elements of visual perception- Image sensing and acquisition- Image sampling and quantization. Pixel relationships- Statistical properties- Histogram, mean, Standard deviation-. Color Image Fundamentals, Chromaticity diagram. Color models- Image file formats, Image transforms, Discrete fourier transform- Discrete cosine transform- wavelet transform.

IMAGE ENHANCEMENT AND RESTORATION (9)

Enhancement in spatial domain- Basic gray level transforms- Histogram processing- Spatial Filtering- Enhancement in frequency domain- Image restoration- Degradation model- Noise models- Spatial Filters- Frequency domain filters

IMAGE SEGMENTATION AND REPRESENTATION (9)

Detection of discontinuities- Point, Line and Edge detection- Gradient operators- Thresholding- Region based segmentation- Representation schemes- Chain codes- Polygon approximation- Boundary descriptors- Simple descriptors- Shape number- Fourier descriptors.

VIDEO FUNDAMENTALS (9)

Basic concepts and Terminology-Monochrome Analog video – Color in Video – Anlog video standards – Digital video basics – Analog-to Digital conversion – Color representation and chroma sub sampling – Digital video formats and standards Video sampling rate and standards conversion.

VIDEO OBJECT EXTRACTION (9)

Back ground subtraction – Frame difference – Static and dynamic background modeling – Optical flow techniques – Handling occlusion – Scale and appearance changes – Shadow removal.

TOTAL:45 PERIODS

Reference Books:

1. *Rafael C. Gonzalez, Richard E. Woods,* ***"Digital Image Processing",*** *Pearson Education, Inc., Second Edition, 2004.*
2. *Anil K. Jain,* ***"Fundamentals of Digital Image Processing",*** *Prentice Hall of India, 2002.*
3. *Oges Marques, "****Practical Image and Video Processing Using MATLAB"****, Wiley-IEEE Press, 2011.*
4. *A.Bovik,* ***"Handbook of Image and Video processing"****, 2nd Edition, Academic press, 2005.*
5. *Mark Nixon and Alberto Aguado,* ***"Feature Extraction and Image Processing"****, Academic Press, 2008.*
6. *Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,* ***"Digital Image Processing using MATLAB",*** *Pearson Education, Inc., 2004.*
7. *Jayaraman S, Esakkirajan S and Veerakumar J,* ***"Digital Image Processing",*** *Tata McGraw Hill Education pvt ltd, 2010.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	2	2	3	2	1	1	1	3	-
CO2	3	3	2	2	3	3	1	1	3	3	-
CO3	3	3	2	2	3	3	1	1	3	3	-

16AEPE02 MIXED SIGNAL CIRCUITS AND INTERFACING (Common to VLSI design)	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- A-D & D-A Converters.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To gain basic knowledge on Sample and Hold Architecture.
- To acquire knowledge on various A-D & D-A converters Architecture.
- To gain Knowledge on Building Blocks & Precision Techniques

***COURSE OUTCOMES*:**

Upon completion of this course the students will have:

CO1: Basic knowledge on Sample and Hold Architecture.
CO2: Knowledge on various A-D & D-A converters Architecture.
CO3: Knowledge on Building Blocks & Precision Techniques

***TOPICS COVERED*:**

SAMPLE-AND-HOLD ARCHITECTURES (9)

Introduction to Data conversion and Processing**-** Sampling Switches-MOS, Diode Switches-Improvements in MOS Switch Performance-Conventional Open-Loop and Closed-Loop Architecture, Open-Loop Architecture with Miller Capacitance, Multiplexed-Input Architectures, Recycling Architecture, Switched-Capacitor Architecture, Current-Mode Architecture.

DIGITAL-TO-ANALOG CONVERTER ARCHITECTURES (9)

Basic principles-General Considerations-Performance Metrics-Reference Multiplication and Division-Switching and Logical Functions in DACs-Resistor-Ladder DAC Architectures, Current-Steering Architectures.

ANALOG-TO-DIGITAL CONVERTER ARCHITECTURES (9)

General Considerations- Performance Metrics- Flash Architectures, Two-Step Architectures, Interpolative and Folding Architectures, Pipelined Architectures, Successive Approximation Architectures, Interleaved Architectures.

BUILDING BLOCKS OF DATA CONVERSION SYSTEMS (9)

Amplifiers- Open-Loop Amplifiers, Closed-Loop Amplifiers, Operational Amplifiers, Gain Boosting Techniques, Common-Mode Feedback. Comparators- Bipolar Comparators, CMOS Comparators, BiCMOS Comparators.

APPLIED ELECTRONICS

PRECISION TECHNIQUES **(9)**

Comparator Offset Cancellation- Input, Output and multistage Offset Storage, Comparators Using Offset-Cancelled Latches- Op Amp Offset Cancellation- Calibration Techniques- DAC and ADC Calibration Techniques.

TOTAL:45 PERIODS

Reference Books:

1. *BehzadRazavi,"**PrinciplesofDataConversionSystemDesign**", JohnWiley& Sons,2011.*
2. *SundaramNatarajan,"**MicroelectronicsAnalysis&design"**,McGrawHill2006*
3. *R.JBaker,"**CMOSMixedSignalCircuitDesign**",WileyInterscience,2nd Edition,2009.*
4. *B.Razavi,"**DesignofAnalogCMOSIntegratedCircuits**",McGrawHill,2005.*
5. *DavidA. Johns and Ken Martin, "**Analog Integrated Circuit Design**",Wiley India,2008.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	2	2	-	2	1	1	2	2
CO2	3	-	2	-	-	-	-	-	-	-	-
CO3	3	3	1	-	2	-	1	-	1	-	-

16AEPE03 RF SYSTEM DESIGN (Common to VLSI design)	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Transmission Lines,RF System.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To gain knowledge on issues in designing RFIC and concepts of transistors.
- To gain knowledge onintegrated circuits design using Passive components.
- To gain knowledge onRF Amplifiers and RF Mixers designs.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have::

CO1 :Detailed Knowledge on issues in designing RFIC and concepts of transistors.
CO2 :Ability to design integrated circuits using Passive components.
CO3 : Detailed Knowledge on RF Amplifiers and RF Mixers designs.

***TOPICS COVERED*:**

ISSUES IN RFIC DESIGN, NOISE, LINEARITY, AND FILTERING: **(9)**

Lower frequency analog design and microwave design versus radio frequency integrated circuit design - Impedance levels for microwave and low-frequency analog design- noise - linearity and distortion in RF Circuits - dynamic range - filtering issue.

REVIEW OF TECHNOLOGY : **(9)**

Small -signal model of bipolar transistor - high frequency effects - noise in bipolar transistors - base shot noise-noise sources in the transistor model - bipolar transistor design considerations-CMOS transistor.- impedance matching - tapped capacitors and inductors - the concept of mutual inductance - tuning a transformer - bandwidth of an impedance transformation network-quality factor of an LC resonator.

DESIGN OF PASSIVE CIRCUIT ELEMENTS IN IC TECHNOLOGIES: **(9)**

Technology backend and metallization in IC technologies - sheet resistance and skin effect -parasitic capacitance and inductance -current handling in metal lines-design of inductors and transformers - characterization of inductor-layout of spiral inductors - on-chip transmission lines - high frequency measurements of on-chip passives and common De-Embedding techniques-packaging.

LNA AND POWER AMPLIFIER: **(9)**

Basic amplifiers - amplifiers with feedback - noise in amplifiers - linearity in amplifiers - differential pair and other differential amplifiers-low-voltage topologies for LNAs and the use of on-chip transformers - DC bias networks - temperature effects - broad band LNA design. Power amplifier: power capability -

efficiency calculations - matching considerations - Class A,B,C.D.E.F,G,H and S amplifiers -summary of amplifier classes for RF Integrated circuits - AC load line - matching to achieve desired power - packaging -effects and implications of non linearity - linearization techniques - CMOS power amplifier example.

MIXERS: **(9)**

Mixing with nonlinearity - basic mixer operation - controlled transconductance mixer - double- balanced mixer - mixer with switching of upper quad - analysis of switching modulator-mixer noise - linearity - improving isolation - image reject and single -sideband mixers-alternative mixer designs - general design comments-CMOS mixers.

TOTAL:45 PERIODS

Reference Books:

1. *John Rogers and Calvin Plett, "**Radio Frequency Integrated Circuit Design",**Artech House, 2002.*
2. *Stephan A Mass, **"Non-Linear Microwave and RF circuits"**, Artech House.*
3. *FerriLosee, "**RF Systems, Components and Circuits handbook",**Artech house, 2002.*
4. *Larson LE, **"RF and Microwave Circuit for Wireless Applications",**Artech House, 1997.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	1	1	1	1	-	-	1
CO2	2	3	-	-	1	-	-	1	-	-	1
CO3	1	-	1	1	1	1	-	1	1	-	-

APPLIED ELECTRONICS

16AEPE04 MICROSENSORS AND MEMS (Common to VLSI design)	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Basic science, Basic engineering.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment

***COURSE OBJECTIVES*:**

- To understand the microfabrication process, MEMS materials and various system issues.
- To acquire basic knowledge on electrical and mechanical concepts of MEMS.
- To acquire knowledge on various types of microsensors.
- To introduce the concepts of optical and RF MEMS and various case studies.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO 1: Knowledge on microfabrication process, MEMS materials and various system issues.
CO 2: Basic knowledge on electrical and mechanical concepts of MEMS.
CO 3: Knowledge on various types of microsensors.
CO 4: Introduction to optical and RF MEMS and various case studies.

***TOPICS COVERED*:**

MICROFABRICATION AND MATERIALS (9)

Introduction – Evolution of MEMS – Microsensors and actuators – Microfabrication – Lithography, Etching, Deposition, Oxidation, Diffusion - MEMS materials – Metals – Physical and chemical properties, Metallization – Semiconductors – Electrical and chemical properties, Growth and Deposition – Bulk and Surface micromachining.

ELECTRICAL AND MECHANICAL CONCEPTS (9)

Conductivity and resistivity – Elasticity – Stress and strain – Isotropic and Anisotropic materials – Bending of beams – types, Deflection – Pure bending – Torsional deflections – intrinsic stress – Resonance – Viscosity - Surface tension.

MEMS ISSUES AND CASE STUDIES (9)

Circuit and System issues – Electronics, Feedback systems and Noises. Case studies – Commercial pressure sensor, MEMS magnetic actuators, Capacitive accelerometer.

TYPES OF MICROSENSORS (9)

Introduction – Thermal sensors, Radiation sensors, Mechanical sensors – Pressure microsensors and Flow microsensors, Magnetic sensors, Bio(Chemical) sensors – SAW-IDT microsensor – fabrication – applications – Strain, Temperature, Pressure and Humidity sensor.

APPLIED ELECTRONICS

OPTICAL AND RF MEMS **(9)**

Optical MEMS – Passive MEMS optical components – Lenses, Mirrors – Active actuators for optical MEMS – Translation and rotation motion – RF MEMS – Basics - Sample case studies of optical and RF MEMS.

TOTAL:45 PERIODS

Reference Books:

1. *Stephen Santuria,**" Microsystems Design",** Kluwer publishers, 2000.*
2. *Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "**Micro Sensors MEMS and SmartDevices**", John Wiley & Son LTD, 2002.*
3. *Chang Liu, **"Foundations of MEMS"**, Pearson Education Inc., 2006.*
4. *NadimMaluf,**" An introduction to Micro electro mechanical system design"**, Artech House, 2000.*
5. *Mohamed Gad-el-Hak, editor,**" The MEMS Handbook",** CRC press Baco Raton, 2000.*
6. *Tai Ran Hsu,**"MEMS & Micro systems Design and Manufacture"** Tata McGraw Hill, New Delhi, 2002.*
7. *James J.Allen, **"Micro Electro Mechanical System Design",** CRC Press Publisher, 2010.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	2	-	-

APPLIED ELECTRONICS

16AEPE05 GRAPH THEORY AND OPTIMIZATION TECHNIQUES (Common to VLSI design)	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- NIL

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To solve problems in graphs and trees.
- To implement the appropriate graph theoretic algorithms for the given problem.
- To solve the optimization problem using linear and non-linear programming

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO 1: An ability to solve problems in graphs and trees.
CO 2: An ability to apply graph theoretic algorithms for the given problem.
CO 3: An ability to solve the optimization problem using linear and non-linear programming.

TOPICS COVERED

GRAPHS AND TREES ***(9)***

Basic definitions and examples of graph - Subgraphs – Isomorphism - Operations on Graphs – Hamiltonian path and Euler graph - Connectivity – Matrix representation of graphs – Directed graphs Trees – properties of trees – Spanning tree.

GRAPH COLORING **(9)**

Planar graphs – Different representation, Graph duality – Geometric dual and Combinatorial dual - Graph coloring – Chromatic number - Chromatic partitioning – Coverings – Matchings - Four color problem – Regularization of a planar graph.

GRAPH THEORETIC ALGORITHMS **(9)**

Computer representation of a graph - Some basic algorithms for graph – Shortest path algorithms for specified vertex to another vertex and all pairs of vertices – Minimal spanning tree algorithm – Kruskal and Prim's algorithm – Depth first and breadth first search algorithms.

CLASSICAL OPTIMIZATION AND LINEAR PROGRAMMING **(9)**

Single variable optimization – Multivariable optimization with various constraints – Lagrange's method, Kuhn-Tucker condition – Linear Programming – Simplex method – Unbounded and infinite number of solutions – Duality in linear programming – Transportation problem.

NON-LINEAR PROGRAMMING **(9)**

Elimination methods – Unrestricted search, Fibonacci method, Golden section method – Unconstrained minimization – Direct search methods - Random search methods and Grid search methods, Indirect search methods – Steepest descent method and conjugate gradient method.

APPLIED ELECTRONICS

TOTAL:45 PERIODS

Reference Books:

1. *NarsinghDeo, "**Graph Theory with Applications to Engineering and Computer Science,"** PHI, 2004.*
2. *Rao S.S., **"Engineering Optimizations: Theory and Practice",** New Age International Pvt. Ltd., 4th Edition, 2009.*
3. *Douglas B. West, **"Introduction to Graph Theory",** Prentice Hall of India, 2001.*
4. *Robin J. Wilson, **"Introduction to Graph Theory",** Pearson Education 4th edition, 2007.*
5. *Kalyanmoy Deb, **"Optimization for Engineering Design – Algorithms and Design",** PHI, 2012.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	1	-	-	-	-	-	-	-	-
CO2	-	2	1	-	-	-	-	-	-	-	-
CO3	1	2	2	-	-	-	-	-	-	-	-

APPLIED ELECTRONICS

16AEPE06 NEURAL NETWORKS (Common to VLSI design)	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- NIL

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To give Exposure to artificial neurons, learning and default multi-layered networks & local minima networks.
- To Understand the concepts of global minima networks, associative memories and competitive neural networks.
- To Study pattern matching, character recognition and speech recognition neural networks.

***COURSE OUTCOMES*:**

Upon completion of the course, the students will have/ability to:

CO1**:** Exposure to artificial neurons, learning and default multi-layered networks &local minima networks.

CO2**:** Understanding of global minima networks, associative memories and competitive neural networks.

CO3**:** Knowledge on pattern matching, character recognition and speech recognition neural networks.

***TOPICS COVERED*:**

INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS (9)

Neuro-physiology - General Processing Element - ADALINE - LMS learning rule - MADALINE - MR2 training algorithm.

BPN AND BAM (9)

Back Propagation Network - updating of output and hidden layer weights -application of BPN – associative memory - Bi-directional Associative Memory - Hopfield memory - travelling sales man problem.

SIMULATED ANNEALING AND CPN (9)

Annealing, Boltzmann machine - learning - applications - Counter Propagation network - architecture - training - Applications.

SOM AND ART (9)

Self organizing map - learning algorithm - feature map classifier - applications - architecture of Adaptive Resonance Theory - pattern matching in ART network.

NEOCOGNITRON **(9)**

Architecture of Neocognitron - Data processing and performance - Architecture of spacio - temporal networks for speech recognition.

TOTAL : 45 PERIODS

Reference Books:

1. *J.A. Freeman and B.M.Skapura , "**Neural Networks, Algorithms Applications and ProgrammingTechniques**", Pearson 2011.*
2. *LaureneFausett, **"Fundamentals of Neural Networks: Architecture, Algorithms andApplications",**Pearson education India 2006.*
3. *Simon Haykin, **"Neural Networks & Learning Machines"** third edition Pearson Education 2011.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	2	2	-	-	-	-	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-
CO3	3	3	-	2	2	-	-	-	-	-	-

APPLIED ELECTRONICS

16AEPE07 ELECTRONIC PACKAGING TECHNOLOGIES (Common to VLSI design)	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Semiconductor Devices.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To Give Exposure on IC Packaging with the associated issues like thermal, speed, signal and integrity power etc.
- To Gain Knowledge on the appropriate packaging styles and design procedures.
- To Gain Knowledge on CAD used in designing wiring boards.

***COURSE OUTCOMES*:**

Upon completion of the course students will have:

CO1: Exposure on IC Packaging with associated issues like thermal, speed, signal and integrity power etc.

CO2: Knowledge on the appropriate packaging styles and design procedures.

CO3: Knowledge on CAD used in designing wiring boards.

***TOPICS COVERED*:**

OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING (9)

Introduction of an Electronic system and history of semiconductors - Products and levels of packaging - Packaging aspects of handheld products - Definition of PWB - Basics of Semiconductor and Process flowchart - Wafer fabrication, inspection and testing - Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding - TAB and flip chip.

SEMICONDUCTOR PACKAGES (9)

Single chip packages or modules (SCM) - Commonly used packages and advanced packages - Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Electrical Design considerations in systems packaging, Resistive, Capacitive and Inductive Parasitics - Layout guidelines and the Reflection problem - Interconnection.

CAD FOR PRINTED WIRING BOARDS (9)

Benefits from CAD; Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights - Beginning a circuit design with schematic work and component, layout, DFM check, list and design rules; Design for Reliability, Printed Wiring Board Technologies: Board-level packaging aspects, Review of CAD output files for PCB fabrication; Photo plotting and mask generation, Process flow-chart; Vias; PWB substrates; Surface preparation, Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs, PWB etching; PWB etching; Resist stripping; Screen-printing technology, through-hole manufacture process steps; Panel and pattern plating methods, Solder mask for PWBs; Multilayer PWBs; Introduction to, microvias, Microvia technology and Sequential build-up technology process flow for high-density, interconnects.

APPLIED ELECTRONICS

SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS (9)

SMD benefits; Design issues; Introduction to soldering, Reflow and Wave Soldering methods to attach SMDs, Solders; Wetting of solders; Flux and its properties; Defects in wave soldering, Vapour phase soldering, BGA soldering and De-soldering/Repair; SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead freevAlloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling, Issues, Thermal Design considerations in systems packaging (L. Umanand, Thermal Design considerations in systems packaging.

EMBEDDED PASSIVES TECHNOLOGY (9)

Introduction to embedded passives - Need for embedded passives - Design Library; Embedded resistor processes - Embedded capacitors - Processes for embedding capacitors.

TOTAL: 45 PERIODS

Reference Books:

1. *Tummala, Rao R.,* ***Fundamentals of Microsystems Packaging****, McGraw Hill Reference Book 2001.*
2. *Blackwell (Ed),* ***The electronic packaging handbook****, CRC Press,1999.*
3. *Tummala, Rao R,* ***Microelectronics packaging handbook****, McGraw Hill ,1997.*
4. *Bosshart,* ***Printed Circuit Boards Design and Technology****, Tata McGraw Hill ,2002.*
5. *William D. Brown,* ***"Advanced Electronic Packaging"****, IEEE Press, 1999.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	2	2	1	2	2	-	-	1
CO2	2	1	1	2	2	-	2	2	-	-	1
CO3	1	1	1	2	3	-	3	1	-	-	1

APPLIED ELECTRONICS

16AEPE08 NANO ELECTRONICS (Common to VLSI design)	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*: Elective**

PREREQUISITES:

- Semiconductor theory.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To gain knowledge in particles, waves and materials for Nano Electronics.
- To understand growth, fabrication and measurement techniques for nanostructures.
- To gain knowledge on Nano Structure and Devices.

***COURSE OUTCOMES*:**

The upon completion of this course students will have:

CO 1: Depth knowledge in particles, waves and materials for Nano Electronics.

CO 2: An ability to understand growth, fabrication and measurement techniques for nanostructures.

CO3: Knowledge on Nano Structure and Devices.

***TOPICS COVERED*:**

PARTICLES, WAVES AND WAVE MECHANICS (9)

Introduction -Classical particles -Classical waves -Wave–particle duality -Wave mechanics-The Schrodinger wave equation-Wave mechanics of particles-Atoms and atomic orbitals.

MATERIALS FOR NANO ELECTRONICS (9)

Introduction -Semiconductors -Crystal lattices: bonding in crystals -Electron energy bands -Semiconductor heterostructures - Lattice-matched and pseudomorphicheterostructures - Organic semiconductors -Carbon nonmaterial: nanotubes and fullerenes.

GROWTH, FABRICATIONAND MEASUREMENT TECHNIQUES FOR NANO STRUCTURES (9)

Bulk crystal and heterostructure growth -Nanolithography, etching, and other means for fabrication of nanostructures and nanodevices -Techniques for characterization of nanostructures -Spontaneous formation and ordering of nanostructures -Clusters and nanocrystals -Methods of nanotube growth -Chemical and biological methods for nanoscale fabrication -Fabrication of nanoelectromechanical systems.

ELECTRON TRANSPORT IN SEMICONDUCTORS AND NANOSTRUCTURES (9)

Time and length scales of the electrons in solids -Statistics of the electrons in solids and nanostructures -The density of states of electrons in nanostructures -Electron transport in nanostructures. Electrons in traditional low-dimensional structures- Electrons in quantum wells -Electrons in quantum wires -Electrons in quantum dots.

NANOSTRUCTURE DEVICE (9)

Resonant-tunneling diodes - Field-effect transistors -Single-electron-transfer devices -Potential-effect transistors -Light-emitting diodes and lasers -Nanoelectromechanical system devices -dot cellular automata.

TOTAL: 45 PERIODS

Reference Books:

1. *Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, "**Introduction to Nan electronics: Science, Nanotechnology, Engineering, and Applications**", Cambridge University Press 2011.*
2. *Supriyo Datta,"**Lessonsfrom Nanoelectronics: A New Perspective on Transport**", World Scientific 2012.*
3. *George W. Hanson, "**Fundamentals of Nanoelectronics**", Pearson 2009.*
4. *Mircea Dragoman, Daniela Dragoman, "**Nanoelectronics: principles and devices**", CRC Press 2006.*
5. *Karl Goser, Peter Glösekötter, Jan Dienstuhl,"**Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices**", Springer 2004.*
6. *Mark A. Reed, Takhee Lee, "**Molecular nanoelectronics**", American Scientific Publishers 2003.*
7. *Jaap Hoekstra, "**Introduction to Nan electronic Single-Electron Circuit Design**", Pan Stanford Publishing 2010.*
8. *W. Ranier,"Nano **Electronics and Information Technology**", John Wiley & Sons 2012.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	1	3	2	-	1	1	-	1
CO2	2	2	1	1	2	-	2	-	1	1	2
CO3	1	1	3	2	2	1	-	1	1	-	1

APPLIED ELECTRONICS

16AEPE09 REAL TIME OPERATING SYSTEM (Common to VLSI design)	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Operating System.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To learn issues related to the design and analysis of systems with real time Constraints and features of Real time OS.
- To learn about various Uniprocessor and Multiprocessor scheduling mechanisms.
- To get knowledge on real time communication protocols.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO1: Knowledge on issues related to the design and analysis of systems with real timeConstraints and features of Real time OS.
CO2: Ability to analyze various Uniprocessor and multiprocessor scheduling mechanism.
CO3: Knowledge on real time communication protocols.

***TOPICS COVERED*:**

INTRODUCTION TO REAL TIME OPERATING SYSTEM (9)

Introduction to Real time computing Concepts, Example of real time applications-Structure of a real time system-Characterization of real time systems and tasks- Hard and Soft timing constraints -Design challenges- Performance metrics -Prediction of Execution time: Source code analysis, Micro -architecture level analysis, Cache and pipeline issues -Programming Languages for Real -Time System.

REVIEW OF RTOS (9)

Real time OS-Threads and Tasks-Structure of Microkernel-Time services-Scheduling Mechanisms Communication and Synchronization-Event Notification and Software interrupt.

TASK SCHEDULING AND ALGORITHMS (9)

Task assignment and Scheduling -Task allocation algorithms- Single processor and Multiprocessor task scheduling- Clock driven and Priority based scheduling algorithms -Fault tolerant Scheduling.

REAL TIME PROTOCOLS (9)

Real Time Communication Network-Topologies and architecture issues-protocols-contension based, token based, polled bus, deadline based protocol, Fault tolerant routing.RTP and RTCP.

REAL TIME DATABASES (9)

Real time Databases-Transaction priorities-Concurrency control issues-Disk scheduling algorithms-Two phase approach to improve predictability.

TOTAL : 45 PERIODS

Reference Books:

1. *Jane W.S. Liu, **Real Time Operating Systems**, Pearson Education India, 2000.*
2. *Philip A. Laplante and Seppo J. Ovaska, **"Real Time Operating Systems Design and Analysis: Tools for the Practitioner''** IV Edition IEEE Press, Wiley. 2013.*
3. *C.M. Krishna, Kang G. Shin – **" Real Time Operating Systems",** International Edition, McGraw Hill Companies, Inc., New York, 2013.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	2	-	1	2	2	-
CO2	3	3	2	2	2	2	-	1	2	3	-
CO3	3	3	2	2	2	2	-	1	2	2	-

APPLIED ELECTRONICS

16AEPE10 VLSI SIGNAL PROCESSING	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:
- Digital signal processing.
- VLSI Architecture.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

COURSE OBJECTIVE:
- To improve the performance of the existing FIR filter structures to suit VLSI designs.
- To design efficient IIR filter structures and Bit level architectures suitable for VLSI Designs.
- To modify the clocking styles, synchronous and Asynchronous protocols suitable for VLSI Architectures.

COURSE OUTCOMES:
Upon completion of this course the students will have:

CO1 : Ability to improve the performance of the existing FIR filter structures to suit VLSI designs.
CO2 : Ability to design efficient IIR filter structures and Bit level architectures suitable for VLSI designs.
CO3 : Ability to modify the clocking styles, synchronous and Asynchronous protocols suitable for VLSI Architectures.

***TOPICS COVERED*:**

INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS (9)

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm,Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

RETIMING, ALGORITHMIC STRENGTH REDUCTION (9)

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS (9)

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

BIT-LEVEL ARITHMETIC ARCHITECTURES (9)

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters.

NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING (9)

Numerical strength reduction – subexpression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining, Asynchronous pipelining, bundled data versus dual rail protocol.

TOTAL:45 PERIODS

Reference Books:

1. *Keshab K. Parhi, " **VLSI Digital Signal Processing Systems, Design and implementation** ", Wiley, Interscience, 2007.*
2. *U. Meyer – Baese, " **Digital Signal Processing with Field Programmable Gate Arrays**", Springer, Second Edition, 2004.*
3. *Kung S. Y, H. J. While House, T. Kailath, "**VLSI and Modern Signal Processing**", Prentice Hall,1985.*
4. *Jose E. France, YannisTsividis"**Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing**", Prentice Hall, 1994.*
5. *Medisetti V. K, "**VLSI Digital Signal Processing**", IEEE Press (NY), USA,1995.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	1	-	1	1	-	1	1	-	-
CO2	2	-	1	-	1	1	1	-	-	-	1
CO3	2	-	1	-	1	1	-	1	-	-	1

APPLIED ELECTRONICS

16AEPE11 ASIC DESIGN	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:**Elective

PREREQUISTES:

- VLSI Technology.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To Gain the fundamentals of ASIC design.
- To Gain Knowledge on programmable ASIC s.
- To Gain Knowledge in the logical synthesis , simulation and testing aspects of ASIC .

***COURSE OUTCOMES*:**

After completing this course, the students will have:

CO1: Sufficient theoretical knowledge for carrying out the ASIC design.
CO2: Knowledge about programmable ASIC s.
CO3:Knowledge in the logical synthesis , simulation and testing aspects of ASIC .

***TOPICS COVERED*:**

OVERVIEW OF ASIC AND PLD (9)

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 .

PROGRAMMABLE ASICs (9)

Programmable ASIC Logic cells for ACTEL and XILINX-DC & AC inputs and outputs –Clock and Power inputs – ACTEL and XILINX I/O blocks –Programmable ASIC Architecture:Xilinx XC 4000-FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance, Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs .

ASIC PHYSICAL DESIGN (9)

System partition Partitioning - Partitioning methods – Interconnect delay models and measurement of delay - Floor planning - Placement – Routing : Global routing - Detailed routing - Special routing.

LOGIC SYNTHESIS, SIMULATION AND TESTING (9)

Design systems - Logic Synthesis - Verilog and VHDL synthesis - Types of simulation -Boundary scan test - Fault simulation - Automatic test pattern generation.

HIGH PERFORMANCE ALGORITHMS FOR ASICS/ SOCS. (9)

DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM, High speed data standards.

TOTAL : 45PERIODS

APPLIED ELECTRONICS

Reference Books:

*1. M.J.S.Smith, " **Application - Specific Integrated Circuits",** Pearson,2003.*
*2. Steve Kilts, **"Advanced FPGA Design,"** Wiley Inter-Science.*
*3. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, "**FPGA-based Implementation of Signal Processing Systems",** Wiley, 2008.*
*4.Mohammed Ismail and Terri Fiez, **"Analog VLSI Signal and Information Processing ",** McGraw Hill, 1994.*
*5. Douglas J. Smith, **HDL Chip Design**, Madison, AL, USA: Doone Publications, 1996.*
*6. Jose E. France, YannisTsividis, **"Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing",** Prentice Hall, 1994.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	-	-	2	2	2	2	3
CO2	3	2	2	1	1	-	-	2	2	2	3
CO3	1	3	-	-	-	-	2	2	2	2	3

APPLIED ELECTRONICS

16AEPE12 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Electromagnetic Fields and Radiation.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To understand the concepts related to Electromagnetic interference in PCBs. and provide solutions for minimizing EMI in PCBs.
- To learn EMI standards, EMI coupling principles, and measurements in the design of PCBs.
- To provide knowledge on EMI control techniques and design procedures to make EMI compatible PCBs.

***COURSE OUTCOMES*:**
Upon completion of this course the students will be able to:

CO1: Analyze Electromagnetic interference effects in PCBs.
CO2: Propose solutions for minimizing EMI in PCBs.
CO3: Analyze Electromagnetic environment, EMI coupling, standards, measurement and control techniques.

***TOPICS COVERED*:**

EMI/EMC CONCEPTS (9)

EMI-EMC definitions and Units of parameters,Sources and victim of EMI,Conducted and Radiated EMI Emission and Susceptibility,Transient EMI, ESD,Radiation Hazards.

EMI COUPLING PRINCIPLES (9)

Conducted, radiated and transient coupling,Common ground impedance coupling Common mode and ground loop coupling,Differential mode coupling, Near field cable to cable coupling, cross talk,Field to cable coupling , Power mains and Power supply coupling.

EMI CONTROL TECHNIQUES (9)

Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.

EMC DESIGN OF PCBS (9)

Component selection and mounting,PCB trace impedance,Routing,Cross talk control,Power distribution decoupling, Zoning,Grounding,VIAsconnection,Terminations.

EMI MEASUREMENTS AND STANDARDS (9)

Open area test site, TEM cell, EMI test shielded chamber and shielded ferrite lined anechoic chamber,Tx

/Rx Antennas, Sensors, Injectors / Couplers, and coupling factors, EMI Rx and spectrum analyzer, Civilian standards-CISPR, FCC, IEC, EN,Military standards-MIL461E/462.

TOTAL:45 PERIODS

Reference Books:

1. *V.P.Kodali, **—Engineering EMC Principles, Measurements and Technologies**, IEE Press, Newyork, 1996.*
2. *Henry W.Ott.,**Noise Reduction Techniques in Electronic Systems**, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.*
3. *Bemhard Keiser, **—Principles of Electromagnetic Compatibility**, 3rd Ed, Artech house, Norwood, 1986.*
4. *C.R.Paul,**Introduction to Electromagnetic Compatibility** , John Wiley and Sons, Inc, 1992.*
5. *Don R.J.White Consultant Incorporate, **—Handbook of EMI/EMC, Vol I-V**, 1988.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	2	2	1	2	1	1	2	2
CO2	-	3	3	1	3	2	1	2	2	-	2
CO3	2	2	2	1	3	2	-	2	2	2	2

APPLIED ELECTRONICS

16AEPE13 SOLID STATE DEVICE MODELING AND SIMULATION	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- MOSFET Devices.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To learn the three areas of circuit design, device modeling and CAD tools on which all VLSI system designs are carried out.
- To learn the principles of device modeling wherein device physics and experimentally observed device performance characteristics combined so as to lead to predictable equations and expressions for device performance under various scenarios of excitation.
- To learn the most widely used device models used by the industry including BSIM and EKV models.

***COURSE OUTCOMES*:**

Upon completion of this course the students:

CO1: Will have the knowledge of circuit design, device modeling and CAD tools on which all VLSI system designs are carried out.

CO2: Will understand the principles of device modeling wherein device physics and experimentally observed device performance characteristics combined so as to lead predictable equations and expressions for device performance under various scenarios of excitation.

CO3: Will have the knowledge of most widely used device models used by the industry including BSIM and EKV models.

***TOPICS COVERED*:**

MOSFET DEVICE PHYSICS (9)

Band theory of solids, carrier transport mechanism, MOS capacitor - surface potential accumulation, depletion, inversion, electrostatic potential and charge distribution, threshold voltage, polysilicon work function, interface states and oxide traps, drain current model, sub- threshold characteristics.

MOSFET MODELING (9)

Basic modeling, SPICE Level-1, 2 and 3 models, Short channel effects, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and A.C small signal modeling.

NOISE MODELING (9)

Noise sources in MOSFET, Flicker noise modeling, Thermal noise modeling, model for accurate distortion analysis, nonlinearities in CMOS devices and modeling, calculation of distortion in analog CMOS circuit.

APPLIED ELECTRONICS

BSIM MOSFET MODELING **(9)**

Gate dielectric model, Enhanced model for effective DC and AC channel length and width, Threshold voltage model, Channel charge model, Mobility model, Source/drain resistance model, I-V model, gate tunneling current model, substrate current models, Capacitance models, High speed model, RF model, Noise model, Junction diode models , Layout-dependent parasitics model.

OTHER MOSFET MODELS **(9)**

The EKV model, model features, long channel drain current model, modeling second order effects of the drain current, modeling of charge storage effects, Non-quasi-static modeling, Noise model, temperature effects, MOS model 9, MOSAI model, PSP model, Influence of process variation, Modeling of device mismatch for Analog/RF Application.

TOTAL:45 PERIODS

Reference Books:

1. *TrondYtterdal, Yuhua Cheng and Tor A. Fjeldly, Wayne Wolf,* ***"Device Modeling for Analog and RF CMOS Circuit Design",*** *John Wiley & Sons Ltd.*
2. *B. G. Streetman and S. Banarjee,* ***"Solid State Electronic Devices",*** *Prentice-Hall of India Pvt. Ltd, New Delhi, India.*
3. *A. B. Bhattacharya*, ***" Compact MOSFET Models for VLSI Design",*** *John Wiley & Sons Inc., 2009.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	1	3	2	-	1	2	-	2
CO2	2	2	1	1	2	-	2	-	2	2	2
CO3	1	1	3	2	2	1	-	2	2	-	2

APPLIED ELECTRONICS

16AEPE14 NONLINEAR SIGNAL PROCESSING	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Digital signal processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To gain knowledge in statistical preliminaries for signal processing.
- To understand and apply the order statistics, polynomial and adaptive filters in various scenario.
- To apply filter algorithms and implement filter architectures.
- To gain knowledge on applications and latest trends in non-linear signal processing.

***COURSE OUTCOMES*:**

Upon completion of this course the students will have:

CO 1: Depth knowledge in statistical preliminaries for signal processing.
CO 2: An ability to understand and apply the order statistics, polynomial and adaptive filters in various scenario.
CO 3: An ability to apply filter algorithms and implement filter architectures.
CO 4: Knowledge on applications and latest trends in non-linear signal processing.

***TOPICS COVERED*:**

STATISTICAL PRELIMINARIES (9)

Introduction to nonlinear signal processing – Non-Gaussian random process - Estimators – properties – Maximum likelihood estimation – Robust estimation – Order statistics – L-estimators and R-estimators – Median smoothers – running median, weighted median smoothers - stack smoothers.

ORDER STATISTICS FILTERS (9)

Max/median and multistage median filters – Median hybrid filters – Ranked-order filters – Trimmed mean filters – L-filters - M-filters – R-filters – LMA algorithm - Recursive weighted median filters – Optimal weighted and recursive weighted median filtering.

STABLE MODEL, POLYNOMIAL AND ADAPTIVE FILTERS (9)

Myraid filters – Weighted myriad filters – Polynomial filters – Wiener filters, Power spectrum analysis, Bispectral analysis. Non-linear edge detectors – Adaptive filters bases on local statistics – Decision directed filters – Adaptive L-filters – Comparison.

ALGORITHMS AND ARCHITECTURES (9)

Sorting and selection algorithms – Running median algorithm – Fast structures for median and order statistics filtering - Quadratic digital filters – Implementation and matrix description – Systolic array and Wave front array implementation.

APPLICATIONS AND TRENDS **(9)**

Morphological image processing – Two component image filtering – Color image processing – Homomorphic filtering in image enhancement – Neural network for non-linear filter.

TOTAL:45 PERIODS

Reference Books:

1. *Loannis Pitas, Anastarios, N.Venetsanopoulos,* ***Nonlinear Digital filters – Principles and Applications*** *Kluwer Academic Publishers, 1990.*
2. *GonzaloR. Arce,* ***Nonlinear Signal Processing – A statistical approach****, Wiley Publishers, 2005.*
3. *Kenneth E. Barner, Gonzalo R. Arce,* ***"Nonlinear Signal and Image Processing: Theory, Methods, and Applications"****, CRC Press, 2003.*
4. *JaakkoT.Astola, JaakkoAstolaKuosmanen,* ***Fundamentals of Nonlinear Digital filtering****, CRC Press LLC, 1997.*
5. *Wing Kuen Ling,* ***Nonlinear Digital filters: Analysis and Applications*** *, Elsevier Science & Tech. 2007.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	1	-	1	-	-	-	-	-	-
CO3	-	2	2	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	1	-	-	3	-	-

APPLIED ELECTRONICS

16AEPE15 MIMO WIRELESS COMMUNICATION	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Wireless Communication.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To understand the concept of fading channel, Diversity Techniques and MIMO Channels.
- To acquire basic knowledge on space time block codes, Trellis codes and concatenated codes.
- To acquire knowledge on Space Time Block Codes on Frequency Selective Channels.

***COURSE OUTCOMES*:**

Upon completion of this course the students will have:

CO 1: Knowledge on fading channel, Diversity Techniques and MIMO Channels.

CO 2: Basic knowledge on basic knowledge on space time block codes, Trellis codes and concatenated codes.

CO 3: Knowledge on Space Time Block Codes on Frequency Selective Channels.

***TOPICS COVERED*:**

FADING CHANNEL AND DIVERSITY TECHNIQUES (9)

Wireless channels – Error/Outage probability over fading channels – Diversity techniques – Channel coding as a means of time diversity – Multiple antennas in wireless communications.

CAPACITY AND INFORMATION RATES OF MIMO CHANNELS (9)

Capacity and Information rates of noisy, AWGN and fading channels – Capacity of MIMO channels – Capacity of non-coherent MIMO channels – Constrained signaling for MIMO communications.

SPACE TIME BLOCK AND TRELLIS CODES: (9)

Transmit diversity with two antennas: The Alamouti scheme – Orthogonal and Quasi-orthogonal spacetime block codes – Linear dispersion codes – Generic space-time trellis codes – Basic space-time code design principles – Representation of space-time trellis codes for PSK constellation – Performance analysis for space-time trellis codes – Comparison of space-time block and trellis codes.

CONCATENATED CODES & ITERATIVE DECODING (9)

Development of concatenated codes – Concatenated codes for AWGN and MIMO channels – Turbo coded modulation for MIMO channels – Concatenated space-time block coding.

SPACE TIME BLOCK CODES FOR FREQUENCY SELECTIVE FADING CHANNELS (9)

MIMO frequency-selective channels – Capacity and Information rates of MIMO FS fading channels – Space - time coding and Channel detection for MIMO FS channels – MIMO OFDM systems.-Practical issues in MIMO communication.

TOTAL:45 PERIODS

Reference Books:

1. *Tolga M. Duman and Ali Ghrayeb,* ***"Coding for MIMO Communication systems"****, John Wiley & Sons,West Sussex, England, 2007.*
2. *A.B. Gershman and N.D. Sidiropoulus,* ***"Space-time processing for MIMO communications"****, Wiley,Hoboken, NJ, USA, 2005.*
3. *E.G. Larsson and P. Stoica,* ***"Space-time block coding for Wireless communications"****, CambridgeUniversity Press, 2003.*
4. *M. Janakiraman,* ***"Space-time codes and MIMO systems"****, Artech House, 2004.*
5. *H. Jafarkhani,* ***"Space-time coding: Theory & Practice"****, Cambridge University Press, 2005.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	3	-	2	-	-	-	1	-	-
CO2	1	-	3	1	2	-	-	-	1	-	-
CO3	2	1	-	1	2	-	-	-	1	-	-

APPLIED ELECTRONICS

16AEPE16 MULTICORE ARCHITECTURES	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Computer Architecture.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To get Knowledge on Multiprocessing and Multicore architectures
- To Understand the various multi-core architectures and how they exploit parallelism.
- To get Knowledge on architecture of GPUs, Warehouse-scale computers and embedded processors.

***COURSE OUTCOMES*:**

Upon completion of the course the students will have:

CO1: Knowledge on Multiprocessing and Multicore architectures.
CO2: Ability to understand the various multi-core architectures and how they exploit parallelism.
CO3: Knowledge on architecture of GPUs, Warehouse-scale computers and embedded processors.

***TOPICS COVERED*:**

FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS (9)

Classes of Computers –Trends in Technology, Power, Energy and Cost –Dependability - Measuring, Reporting and Summarizing - Quantitative Principles of Computer Design - Classes of Parallelism – ILP, DLP, TLP and RLP – Multithreading – SMT and CMP Architectures – Limitations of Single Core Processors – The Multicore era – Case Studies of Multicore Architectures.

DLP IN VECTOR, SIMD AND GPU ARCHITECTURES (9)

Vector Architecture - SIMD Instruction Set - Extensions for Multimedia - Graphics Processing Units - Detecting and Enhancing Loop Level Parallelism - Case Studies.

TLP AND MULTIPROCESSORS (9)

Symmetric and Distributed Shared Memory Architectures - Cache Coherence Issues – Performance Issues – Synchronization Issues – Modes of Memory Consistency – Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

RLP AND DLP IN WAREHOUSE-SCALE ARCHITECTURES (9)

Programming Models and Workloads for Warehouse - Scale Computers – Architectures for Warehouse-Scale Computing – Physical Infrastructure and Costs – Cloud Computing – Case studies.

ARCHITECTURES FOR EMBEDDED SYSTEMS (9)

Features and Requirements of Embedded Systems – Signal Processing and Embedded Applications – Digital Signal Processor – Embedded Multiprocessors – Case Studies.

TOTAL:45 PERIODS

Reference Books:

1. *John L Hennessey and David A Patterson,* ***"Computer architecture – A Quantitative Approach"****, Morgan Kaufmann /Elsevier, 5th edition.*
2. *Kai Hwang, NareshJotwani****"Advanced Computer Architecture"****, Tata McGraw-Hill Education, 2nd edition 2010.*
3. *Richard Y.Kain,* ***"Advanced Computer Architecture Systems Design Approach"****, Prentice Hall, 2011.*
4. *David E Culler, Jaswinder Pal Singh, "****Parallel Computing Architecture: A Hardware/Software Approach"****, Morgan Kaufmann/Elsevier, 1997.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	2	2	1	2	2	-	-	1
CO2	2	1	1	3	2	2	2	2	-	-	1
CO3	2	1	1	3	2	2	2	1	-	-	1

APPLIED ELECTRONICS

16AEPE17 BIO TELEMETRY AND TELEMEDICINE	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Communication Engineering,DataSecurity,Computer networking.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To teach the key principles for telemedicine,health,mobile telemedicine and its applications.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have/ability to:

CO1:Aquired knowledge in the area of Telemedicine technology.
CO2:Gain knowledge about the Data security in the medical field.
CO3:Aquired knowledge in Mobile telemedicine and applications.

***TOPICS COVERED*:**

TELEMEDICINE AND HEALTH (9)

History and evolution of telemedicine - Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

TELEMEDICAL TECHNOLOGY (9)

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data –Local and centralized.

TELEMEDICAL STANDARDS (9)

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine ,Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

MOBILE TELEMEDICINE (9)

Tele radiology: Definition, Basic parts of tele radiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

APPLIED ELECTRONICS

TELEMEDICAL APPLICATIONS **(9)**

Telemedicine access to health care services – Health education and self care. · Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – Health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

TOTAL : 45 PERIODS

Reference Books:

1. *Norris, A.C.* ***Essentials of Telemedicine and Telecare.*** *Wiley (ISBN 0-471-53151-0), 2002.*
2. *Wootton R. Craig, J., Patterson, V. (Eds.),* ***Introduction to Telemedicine****. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006.*
3. *O'Carroll, P.W, Yasnoff W.A., Ward E.Ripp, L.H., Martin, E.L. (Eds),* ***Public Health Informatics and Information Systems****. Springer (ISBN 0-387-95474-0), 2003.*
4. *Ferrer-Roca, O., Sosa-Iudicissa, M. (editors),* ***Handbook of Telemedicine****. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.*
5. *Simpson, W. 2006.* ***Video over IP. A practical guide to technology and applications.****Focal Press (Elsevier). ISBN-10: 0-240-80557-7.*
6. *Bemmel, J.H. van, Musen, M.A. (Eds.) (1997).* ***Handbook of Medical Informatics****. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0).*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	2	2	2	2	3
CO2	-	3	2	2	-	-	2	2	2	2	3
CO3	-	-	-	-	2	-	2	2	2	2	3

APPLIED ELECTRONICS

16AEPE18 SATELLITE IMAGE ANALYSIS	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Image processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To gain basic knowledge on satellite image modalities.
- To implement pre-processing and enhancement algorithms for satellite images.
- To gain exposure to various thematic classification techniques.
- To acquire knowledge on image fusion, hyperspectral image analysis and various applications.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO 1: Basic knowledge on satellite image modalities.
CO 2: An ability to implement pre-processing and enhancement algorithms for satellite images.
CO 3: Exposure to various thematic classification techniques.
CO 4: Knowledge on image fusion, hyperspectral image analysis and various applications.

***TOPICS COVERED*:**

BASICS OF SATELLITE IMAGES (9)

Remote sensing principles – Characteristics of remote sensing platforms and sensors - Properties of digital remote sensing data - Data Acquisition alternatives – Analog image digitization, Data already in digital format, Digital image Data formats – Image processing system considerations.

PRE-PROCESSING AND ENHANCEMENT (9)

Basic statistics used in image processing – Radiometric and geometric errors and corrections used in remotely sensed data – Histogram based operation – Univariate and Multivariate image statistics – Image reduction and Magnification - Contrast enhancement – Band ratioing - Spatial filtering – Principal component analysis.

THEMATIC CLASSIFICATION (9)

Feature extraction – Supervised classification – Unsupervised classification – Subpixel classification techniques - Fuzzy classification – Non-parametric classification - Artificial Neural Network (ANN) classifier – Parametric classification - k-NN classifier – Classification accuracy assessment.

IMAGE FUSION AND HYPERSPECTRAL IMAGE ANALYSIS (9)

Multi - image fusion – Feature space fusion, spatial domain fusion, Scale-space fusion. Hyper spectral image processing – feature extraction, classification algorithms – Digital change detection.

APPLICATIONS **(9)**

Retrieval of land surface parameters – temperature, reflectance and water quality – Geographic information system – Fundamental concepts – Geo data processing – Locational and spatial analysis – Visualization – Multi criteria decision analysis of groundwater recharge zones, Assessing flash flood hazards, Archaeological studies.

TOTAL: 45 PERIODS

References Books:

1. *Robert Shcowebgerdt,* ***"Remote sensing models & methods for image processing"****, 2nd edition, 1997.*
2. *John R. Jensen, "***Introductory Digital Image Processing: a Remote Sensing Perspective"***, 3rd edition, Pearson Prentice Hall, 2005.*
3. *Paul Mather,* ***"Computer Processing of Remotely-Sensed Images: An Introduction"****, 4th Edition, John Wiley & Sons, 2010.*
4. *John A. Richards and XiupingJia,* ***"Remote Sensing Digital Image Analysis An Introduction"****, Springer-Verlag Berlin Heidelberg, Fourth Edition, 2006.*
5. *Rafael C. Gonzalez, Richard E. Woods,* ***"Digital Image Processing"****,(3rd Edition) Prentice Hall, 2007.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	1	1	-	2	-	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-
CO4	3	-	-	-	1	-	-	-	-	-	-

APPLIED ELECTRONICS

16AEPE19 DIGITAL CONTROL ENGINEERING	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Digital Control Systems

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To analyze the stability of discrete and digital control systems.
- To design digital control system with deadbeat response and state feedback design.
- To acquire complete knowledge of design tools.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO1 : Ability to analyze the stability of discrete and digital control systems.
CO2 : Ability to design digital control system with deadbeat response and state feedback design.
CO3 : A complete knowledge of design tools.

***TOPICS COVERED*:**

INTRODUCTION TO DIGITAL CONTROL (9)

Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction. Modeling discrete-time systems by pulse transfer function: Review of Z-transforms, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system, Sampled signal flow graph.

STABILITY ANALYSIS OF DISCRETE TIME SYSTEMS (9)

Jury stability test, Stability analysis using bi linear transformation. Time response of discrete systems: Transient and steady state responses, Time response parameters of a prototype second order system, Design of sampled data control systems: Controller design using root locus, Nyquist stability criteria, Bode plot, Lead and Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain.

DEADBEAT RESPONSE DESIGN (9)

Design of digital control systems with deadbeat response, Practical issues with deadbeat response design, Sampled data control systems with deadbeat response, Discrete state space model: Introduction to state variable model, Various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation, Controllability, observability and stability of discrete state space models: Controllability, observability and stability of discrete state space models, Stability, Lyapunov stability theorem.

STATE FEEDBACK DESIGN (9)

Pole placement by state feedback, Set point tracking controller, Full order observer, Reduced order observer, Output feedback design: Output feedback design Theory, Output feedback design Examples, Introduction to optimal control, Basics of optimal control, Performance indices, Linear Quadratic Regulator (LQR) design.

APPLIED ELECTRONICS

DESIGN TOOL **(9)**

Matrices and vectors, Build in function, Saving & loading data, Simulink Models: Selecting objects, Blocks, Connecting blocks, Working with signals data types, Matlab Tool Box: Control systems tool box-linear models, MIMO models, Interconnecting linear model.

TOTAL:45 PERIODS

Reference Books:

1. *Gopal, M., "**Digital Control Engineering**", New Age International. New Delhi.*
2. *Kuo, B. C., "**Digital Control Systems**" , Oxford University Press.*
3. *Kuo, B. C., "**Analysis and Synthesis of sampled-data control system**", PH.*
4. *Houpies, C. H., "**Digital Control Systems (Hardware and Software)**".*
5. *Philips and Nagle, "**Digital Control System Analysis and Design**".*
6. *Matlab basics, **The Mathworks Inc.,2000, www.mathworks.com.***

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	1	1	1	1	-	1	1	-	-
CO2	3	-	1	-	1	-	-	-	1	-	-
CO3	2	1	-	-	1	1	-	1	1	-	-

APPLIED ELECTRONICS

16AEPE20 BIO MEDICAL SIGNAL AND IMAGE PROCESSING	L 3	T 0	P 0	C 3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- Signals and Systems.
- Digital Signal Procesing.
- Digital Image Processing.

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- To Teach the Key principles for Medical signal and Image processing.

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have/ability to:

CO1 :Aquired knowledge in the area of processing Medical signal processing.
CO2:Gain knowledge about the Medical image processing.
CO3:Aquired knowledge in both Signal and Image analysis.

***TOPICS COVERED*:**

BIOMEDICAL SIGNALS (9)

Cardiac electrophysiology- Relation of electrocardiogram (ECG) components to cardiac events- clinical applications Speech Signals: The source-filter model of speech production, spectrographic analysis of speech.Speech Coding: Analysis-synthesis systems, channel vocoders, linear prediction of speech, linear prediction vocoders.

IMAGING MODALITIES (9)

Physics and signal processing for Imaging techniques -Ultrasound, X-ray, Computerized Tomography – Magnetic Resonance Imaging, Positron Emission Tomography, and SPECT.

FUNDAMENTALS OF DETERMINISTIC SIGNAL (9)

Basic properties of Discrete-time systems, Discrete Fourier transform and its properties, the Fast Fourier Transform (FFT), Overlap - Save algorithm, Digital filtering of continuous-time signals - Sampling Revisited: Sampling and aliasing in time and frequency- Spectral analysis- FIR and IIR filters.

PROBABILITY AND RANDOM SIGNALS,PDFS (9)

Introduction to random variables and Probability density functions : Practical techniques for estimating PDFs from real data. Random signals I: Time averages, ensemble averages, autocorrelation functions, cross correlation function , Random signals II: Random signals and linear systems, power spectra, cross spectra, Wiener filters.Blind source separation: Use ofprincipal component analysis (PCA) and independent component analysis (ICA) for filtering.

IMAGE PROCESSING **(9)**

Interpolation, noise reduction methods, edge detection, homomorphicfiltering.Image Segmentation and Registration Image Segmentation: statistical classification, morphological operators, connected components.Image Registration I: Rigid and non-rigid transformations, objective functions.Image Registration II: Joint entropy, optimization methods.

TOTAL:45 PERIODS

Reference Books:

1. *Oppenheim, A. V., and R. W. Schafer, with J. R. Buck.* ***Discrete-Time Signal Processing****. 2nd ed. UpperSaddle River, NJ: Prentice-Hall, 1999. ISBN: 9780137549207.*
2. *Papoulis, A., and S. U. Pillai. Probability,* ***Random Variables, and Stochastic Processes****. New York, NY: McGraw Hill, 2001. ISBN: 9780072817256.*
3. *Siebert***, W. M.** ***Circuits, Signals and Systems****. Cambridge, MA: MIT Press, 1985. ISBN: 9780262192293.*
4. *Duda, R., and P. Hart.* ***Pattern Classification and Scene Analysis****. New York, NY: John Wiley & Sons, 1973. ISBN: 9780471223610.*
5. *Rabiner, L. R., and R. W. Schafer.* ***Digital Processing of Speech Signals****. Upper Saddle River, NJ: Prentice-Hall, 1978. ISBN: 9780132136037.*
6. *5.Lim, J. S.* ***Two-Dimensional Signal and Image Processing****. Upper Saddle River, NJ: Prentice Hall, 1989. ISBN: 9780139353222.*
7. *Epstein, C. L.* ***Mathematics of Medical Imaging.*** *Upper Saddle River, NJ: Prentice Hall, 2003. ISBN: 9780130675484.*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	2	2	-	-	-	2	2	2	2	3
CO2	-	-	-	-	-	-	2	2	2	2	3
CO3	-	3	2	-	2	-	2	2	2	2	3

APPLIED ELECTRONICS

16AEPE21 ULTRASONIC PRINCIPLES AND APPLICATIONS	L	T	P	C
	3	0	0	3

***CORE/ ELECTIVE COURSE*:** Elective

PREREQUISITES:

- NIL

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

- **To understand the concepts of ultrasonic wave formation**
- **To study the dependance of acoustic waves on various parameters and effects of ultrasound on tissues.**
- **To gain knowledge about the scanners and scanning techniques of ultrasound imaging**
- **To give exposure to the diagnostic applications of ultrasonic waves in medicine.**

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have/ability:

CO1: To understand the concepts of ultrasonic wave formation

CO2: To study the dependance of acoustic waves on various parameters and effects of ultrasound on tissues.

CO3: To gain knowledge about the scanners and scanning techniques of ultrasound imaging

CO4: To give exposure to the diagnostic applications of ultrasonic waves in medicine.

***TOPICS COVERED*:**

PRINCIPLES OF ULTRASONICS 9

Introduction, Piezo Electric Devices, The Fields of 'simple', CW excited sources, The Pulsed Acoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays, Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation, Radiation Pressure.

TISSUE-ULTRASOUND INTERACTION 9

Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theory of mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuation and Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissue organization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shear acoustic properties of tissues. Relevanceto tissue characterization, Ultrasound quantitation and tissue characterization.

SCANNING TECHNIQUES 9

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulse echo imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beam forming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converter-Analog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques-Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing. Basic

Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts.

REAL TIME ULTRASONIC SCANNERS 9

Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

ULTRASONIC APPLICATIONS 9

Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations of 3-Dimensional Ultrasound.

TOTAL:45 PERIODS

Reference Books:

1. Shirley Blackwell Cusick, Farman and Vicary, A User's Guide to Diagnostic Ultrasound; Pitman Medical Publishing Co Ltd; Kent, England. (1978).
2. C.R.Hill, Jeff C.Bamber, Gail Haa, Physical Principles of medical Ultrasonics; John Wiley & Sons Ltd; 2nd Edition, 2004.
3. W.N.McDicken, Churchill Livingstone, Diagnostic Ultrasonics – Principles and use instruments New York, 3rd Edition, 1991

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1					2				
CO2			2			1				1	2
CO3	1			2	3						
CO4					3	1		2	2		

APPLIED ELECTRONICS

16AEEE01 PROJECT PHASE I	L 0	T 0	P 12	C 6

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

To expose students to take up real time problems and challenges.
To develop confidence to take up a project independently.
To develop understanding of technical dissertation presentation and writing.

COURSE OUTCOMES:

Upon completion of this course, the students will have:

CO1 :An exposure to take up real time problems and challenges.
CO2: Confidence to take up a project independently.
CO3: An understanding of technical dissertation presentation and writing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	2	2	1	2	1	1	2	2
CO2	-	3	3	1	3	2	1	2	2	-	2
CO3	2	2	2	1	3	2	-	2	2	2	2

APPLIED ELECTRONICS

16AEEE02 PROJECT PHASE II	L 0	T 0	P 24	C 12

***COURSE ASSESSMENT METHODS*:** Both continuous and semester-end assessment.

***COURSE OBJECTIVES*:**

To expose students to take up real time problems and challenges.
To develop confidence to take up a project independently.
To develop understanding of technical dissertation presentation and writing.

COURSE OUTCOMES:

Upon completion of this course, the students will have:

CO1 :An exposure to take up real time problems and challenges.
CO2: Confidence to take up a project independently.
CO3: An understanding of technical dissertation presentation and writing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	2	2	1	2	1	1	2	2
CO2	-	3	3	1	3	2	1	2	2	-	2
CO3	2	2	2	1	3	2	-	2	2	2	2

APPLIED ELECTRONICS