GLA UNIVERSITY
MATHURA
Established vide U.P. Act 21 of 2010.

COURSE STRUCTURE

(w.e.f. Session 2022-23)

M.TECH

(ELECTRONICS & COMMUNICATION ENGG.)

(FULL TIME)

(CBCS)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & TECHNOLOGY

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.	MECC0001	Adaptive Signal Processing	4	0	0	4
2.	MECC0002	Communication Techniques	4	0	0	4
3.	MECC0003	CMOS Analog IC Design	4	0	0	4
4.	MECC0004	Digital Hardware Design	4	0	0	4
5.	MECC0005	Image Processing	4	0	0	4
6.	MECC0800	Signal Processing Lab	0	0	2	1
7.	MECC0801	Communication Lab	0	0	2	1
		TOTAL	**20**	**0**	**4**	**22**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.		Elective-I	4	0	0/2	4/5
2.		Elective-II	4	0	0/2	4/5
3.		Elective-III	4	0	0/2	4/5
4.		Elective-IV	4	0	0/2	4/5
7.	MECJ0950	Minor Project	0	0	0	3
		TOTAL	**16**	**0**	**0-8**	**21+**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.		Elective-V	4	0	0/2	4/5
2.		Elective-VI	4	0	0/2	4/5
3.	MECJ0961	Seminar	0	0	2	1
4.	MECJ0971	Dissertation-I	0	0	8	4
		Total	**8**	**0**	**10**	**13+**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.	MECJ0972	Dissertation- II	0	0	28	14
2.		**Total**	**0**	**0**	**28**	**14**

COURSE STRUCTURE

(w.e.f. Session 2022-23)

M.Tech

(Electronics & Communication Engg.)

(Part Time)

(CBCS)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & TECHNOLOGY

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECC0001	Adaptive Signal Processing	4	0	0	4
2.	MECC0002	Communication Techniques	4	0	0	4
3.	MECC0004	Digital Hardware Design	4	0	0	4
		TOTAL	**12**	**0**	**0**	**12**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.		Elective-I	4	0	0/2	4/5
2.		Elective-II	4	0	0/2	4/5
		TOTAL	**8**	**0**	**0-4**	**10+**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECC0003	CMOS Analog IC Design	4	0	0	4
2.	MECC0005	Image Processing	4	0	0	4
3.	MECC0800	Signal Processing Lab	0	0	2	1
4	MECC0801	Communication Lab	0	0	2	1
5.	MECC0804	Seminar	0	0	2	1
		TOTAL	**8**	**0**	**6**	**11**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.		Elective-III	4	0	0/2	4/5
2.		Elective-IV	4	0	0/2	4/5
4.	MECJ0950	Minor Project	0	0	6	3
		TOTAL	**8**	**0**	**6-10**	**11+**

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.		Elective-V	4	0	0/2	4/5
2.		Elective-VI	4	0	0/2	4/5
3.	MECJ0951	Dissertation-I	0	0	8	4
		Total	**8**	**0**	**8-12**	**12+**

Sixth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECJ0952	Dissertation- II	0	0	28	14
		Total	**0**	**0**	**28**	**14**

ELECTIVES

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1	MECC0006	Low Power VLSI Design	4	0	0	4
2	MECC0802	HDL Programming Lab	0	0	2	1
3	MECC0008	RF and Microwave Techniques	4	0	0	4
4	MECC0803	RF and Microwave Design Lab	0	0	2	1
5	MECC1007	Intelligent Systems and Control	4	0	0	4
6	MECE0001	Embedded Systems	4	0	0	4
7	MECE1002	Information Theory and Coding	4	0	0	4
8	MECE0003	Application Specific Integrated Circuits	4	0	0	4
9	MECE0004	Optimal Control System	4	0	0	4
10	MECE0005	Digital Satellite Communication	4	0	0	4
11	MECE0006	Advanced Data Network	4	0	0	4
12	MECE0007	Speech Processing	4	0	0	4
13	MECE0008	CMOS RF Integrated Circuits	4	0	0	4
14	MECE0009	Optoelectronic Devices	4	0	0	4
15	MECE0010	VLSI Testing and Testability	4	0	0	4
16	MECE0011	Biomedical Signal Processing	4	0	0	4
17	MECE0012	Wireless Communication and Networks	4	0	0	4
18	MECE0013	CAD for VLSI Circuits	4	0	0	4
19	MECE0014	Memory Design and Testing	4	0	0	4
20	MECE0804	Memory Circuit Design Lab	0	0	2	1
21	MECE0805	CMOS RF Integrated Circuits Lab	0	0	2	1

MECC0001: ADAPTIVE SIGNAL PROCESSING

Objectives: To bring out the concepts related to stationary and non-stationary random signals to emphasize the importance of true estimation of power spectral density & introduce the design of linear and adaptive systems for filtering and linear prediction.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basic Concepts of signal processing, IIR & FIR Filters, Random variables, Random Processes, Filtered Random Process, Correlation, Co variance, Power spectrum, Cross Power Spectrum, Ergodicity, Time Averages and estimators **Linear Prediction:** Direct form linear prediction filtering, normal equations for linear prediction filtering, Levinson algorithm, Linear prediction lattice filtering,	20
II	**Digital Wiener Filtering:** Wiener smoothing prediction filter, Application of Weiner smoothing to noise cancelling. **LMS adaptive Filters:** LMS adaptive algorithm, Properties of LMS adaptive filters. **LS Adaptive Filters:** Godard algorithm, lattice **Blind Adaptive Filtering Techniques:** Cost Function, Higher Order Statistics & examples	20

Text book:

- S. Haykin "*Adaptive Filter theory*", Prentice Hall, 4th Edition, 2001

Reference Books:

- "Adaptive filters, Theory and Application" B. Farhang-Boroujeny.
- Ali H. Sayed "*Fundamentals of Adaptive Filtering*", John- Willey Publication, 2003.
- A. Papoulis, S. U. Pillai "*Probability, Random Variables And Stochastic Process*" TMH publication.

Outcomes:

CO 1: Understand the parametric methods for power spectrum estimation.
CO 2: Demonstrate the stochastic signals in the vector space and linear prediction techniques.
Co 3: Apply the adaptive filtering techniques using LMS algorithm and the applications of adaptive filters.
CO 4: Design adaptive filters applying Different LMS Algorithms
CO5: Analyze performance of LMS and RLS algorithm.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO5	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0002: COMMUNICATION TECHNIQUES

Credits: 04 **L–T–P: 4–0–0**

Course Objectives:

- To understand the different basic blocks of digital communication system.
- To design mathematical model of communication channels and digital signals.
- To analyze the signal flow in a digital communication system.
- To analyze the performance of digital communication in the presence of noise and interference.

Module No.		Teaching Hours
I	**Introduction &**review of signals & systems: Elements of electrical communication system, communication channels & their characteristics, mathematical models for communication channels, frequency domain analysis of signals & systems: Fourier series & Fourier transform, power & energy, sampling of band limited signals, band pass signals. Random Theory: Probability & random variables, random processes, description of random processes, statistical averages, stationary processes, random processes & linear systems, random processes in frequency domain, power spectrum of stochastic processes, transmission over LTI systems, Gaussian & white processes, band limited processes and sampling, band pass processes. Digital transmission through additive white Gaussian noise channel-I : Geometric representation of signal waveforms, pulse amplitude modulation, two dimensional signal waveforms, baseband signals, two dimensional band pass signals-carrier phase modulation, two dimensional band pass signals-quadrature amplitude modulation, multidimensional signal waveforms, orthogonal, biorthogonal, simplex and binary coded, optimum receiver for digitally modulated signals in AWGN ,correlation type demodulator ,matched filter type demodulator, the optimum detector, demodulation & detection of carrier amplitude modulated signals, carrier phase modulated signals, quadrature amplitude modulated signals & frequency modulated signals	18
II	Digital transmission through additive white Gaussian noise Channel-I : Probability of error for signal detection in AWGN, probability of error for binary modulation, M-ary PAM, phase coherent PSK modulation, DPSK, QAM, M-ary orthogonal signals, M-ary biorthogonal signals, M-ary simplex Signals and non-coherent detection of FSK, comparison of modulation methods**.** Digital transmission through Band Limited AWGN Channels : Digital PAM transmission through band limited baseband channels, Digital transmission through band limited band pass channels, power spectrum of the baseband signal & carrier modulated signal, Signal design for band limited channels, design of band limited signals for zero ISI-The Nyquist criterion and controlled ISI-partial response signals, probability of error for detection of digital PAM with zero ISI & symbol by symbol detection of data with controlled ISI, probability of error for detection of partial response signals, modulation codes & modulation signals with memory, the maximum-likelihood sequence detection of partial response signals, the power spectrum of digital signals with memory, system design in the presence of channel distortion, design of transmitting & receiving filters for a known channel, channel equalization.	22

Text book:

- John G. Proakis and MasoudSalehi, "*Communication Systems Engineering*", Second Edition, Pearson Education.

Reference Books:

- B.P. Lathi and Zhi Ding, "*Modern Digital And Analog Communication Systems"*, International fourth edition, Oxford University Press.
- S. Haykins, "*Communication Systems",* 5th ed., John wiley.
- M. K. Simon, S. M. Hinedi and W. C. Lindsey, "*Digital Communication Techniques: Signaling And Detection",* Prentice Hall India, N. Delhi, 1995.
- A.Papoulis, S.U.Pillai, Probability, "*Random Variables And Stochastic Processes"*, Mc Graw Hill, fourth Edition.

Course Outcomes:
After successful completion of the course students will be able to

1. Represent the digital signal in baseband and pass-band format.
2. Represent the digital signal in vector space.
3. Design the optimum receiver scheme for digital communication.
4. Analyze the performance of digital communication in presence of noise.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0003: CMOS Analog IC Design

Objectives:

- To provide in-depth understanding of the analog integrated circuit and building blocks
- To provide a basic idea on mixed signal IC design

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	Introduction to CMOS ICs, Body effect , small and large signal behavior of basic amplifier circuits, MOSFET Capacitances, Gain-boosed and Folded Cascode circuits, Cascode - Cascode current mirrors, Introduction to noise Representation of noise in circuits Noise in common-source and cascode circuits, Introduction to negative feedback, Nyquist plots and stability criteria, Loop gain and stability	21
II	Single-stage opamp, Telescopic opamp, Folded-cascode opamp,Two-stage opamp, Fully-differential Opamps, Phase Detectors, PLL building blocks, Charge pump PLL and its limitations, Introduction to VCOs	22

Text books:

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.

Reference books:

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.
- Analysis and Design of Analog Integrated Circuits by Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
- Analog Integrated Circuit Design by David A. Johns, Ken Martin, Wiley Student Edition, 2013.

Course Outcomes: After successfully completing the course students will be able to

CO1: Demonstrate the design step the CMOS Technology

CO2: Explain the various amplifier topology including cascade and cascode

CO3: Analyze the performance of analog circuits

CO4: Design the analog IC design problems including the single and stage amplifier , PLL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0004 : DIGITAL HARDWARE DESIGN

Objectives: The Objective of the course is to provide deep understanding of the design methodologies for combinational, sequential digital systems, arithmetic and logic circuits, accumulator design, fault diagnosis, state finite machines and threshold logic design.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Review of basic building blocks of digital electronics, basic concepts. Analysis and design of typical combinational circuits, analysis and design of synchronous sequential circuits, design of arithmetic circuits, design of logic circuits, design of ALU; Accumulates design, status register, design of shifter, arithmetic and logic operation. Design of computer instructions, register transfer, bus and memory transfer, threshold logic hazards, reliable design and fault diagnosis	20
II	State equivalence and minimization of states, state assignment, state identification and fault detection experiments, asynchronous sequential circuits, races and hazards. Booth's Multiplier, control unit design methods, micro-programmed control, designed of a micro-programmed CPU, Realization with ROM, Main memory array design, auxiliary memory, memory hierarchy, associative memory, virtual memory and memory management concepts, cache memory organization, programmable logic devices, field programmable devices, hardware descriptive language.	20

Text books:

- "*Switching and Finite Automata Theory*" by Z. Kohavi, Tata McGraw-Hill, Second Edition
- "*Fundamentals of Switching Theory and Logic Design*" by Astola and Stankovic, Springer

Reference Books:

- "*Modern Computer Architecture*" by Rafiquzzaman and Chandra, Galgotia Publication.
- "*Computer System Architecture*", M. Morris Mano, PHI.
- Wayne Wolf, **Computers as Components; Principles of Embedded Computing System Design** – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001
- "*Frank Vahid and Tony Givargis*", **Embedded Systems Design – A unified Hardware /Software Introduction**, John Wiley, 2002.

Course Outcomes: After successfully completing the course students will be able to

1. Apply logic fundamentals in the design of memory.
2. Analyze and develop basic logic pipelined machines.
3. Design of state finite machines.
4. Synthesize working circuits using hardware design logic.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0005: IMAGE PROCESSING

Objectives: This course enables the students.

- To define image sampling, quantization, pixels relationship, features, descriptors and classification
- To explain various intensity transformations, image segmentation, various feature extraction approaches, and different classifiers.
- To apply various basic preprocessing (noise reduction, enhancement etc.) and advanced (segmentation, restoration and classification etc.) image processing algorithms.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Digital Image Fundamentals:** Introduction, Fundamental of image, Elements of an image processing system, Image sampling & quantization; Basic relationships between pixels, mathematical Preliminaries: Image transforms. **Image Enhancement:** Gary-Scale Transformation, Piecewise linear transformation, Bit Plane slicing, Histogram Equalization, Enhancement by arithmetic Operations, Smoothing and sharpening using filters, Image blur type and quality measure , image enhancement in frequency domain. **Image Segmentation:** Thresholding, Object labeling, Edge Operators, Edge Linking by Adaptive Mathematical Morphology, Automatic Seeded Region Growing, A Top-Down Region Dividing Approach.	20
II	**Image coding:** Introduction to image coding, Some coding techniques: Run length coding, Bit-plane coding, Sub-band coding. **Image Representation and Description:** Boundary Extraction, Contour Representation, Skeletonization by Thinning, Medial Axis Transformation, Object Representation and Tolerance **Feature Extraction:** Fourier Descriptor and Moment Invariants, Shape Number and Hierarchical Features, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminate Analysis, Feature Reduction in Input and Feature Spaces. **Classifiers:** Bayes Classifier, Support Vector Machine, K-Nearest neighbor (KNN) in Image Analysis. **Case Study:** Face Recognition, Medical Image. Watermarking, Finger Prints. (Any **TWO** case studies to be undertaken by each student)	20

Text books:

- Digital Image Processing, 3rd Edition, by R.C.Gonzalez and R.E.Woods, Prentice Hall
- Solomon, C and Breckon, T. "Fundamentals of Digital Image Processing: a Practical Approach with Examples in MATLAB. John Wiley and sons.
- Bhabatosh Chanda, D. Dutta Majumder (2011). "Digital Image Processing and Analysis", PHI.

References:

- Fundamentals of Digital Image Processing, by Anil K. Jain, Prentice-Hall, 1989
- Digital Image Processing: An Algorithmic Approach; by MA Joshi PHI 2006
- Image Processing and Pattern Recognition: Fundamentals and Techniques, by Frank Y. Shi, Wiley , IEEE

Outcomes: Upon successful completion of this course, students will be able to

1. Define basic terminology of digital image processing.
2. Apply intensity transformations and spatial filtering.
3. Understand the methodologies for image segmentation, restoration etc.
4. Apply image-processing algorithms in practical applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2

MECC0006: LOW POWER VLSI DESIGN

Objectives:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent.
- Power dissipation mechanism in various MOS logic style.
- Identify suitable techniques to reduce the power dissipation.
- Design memory circuits with low power dissipation.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation **Short Channel Effects:** Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Switched Capacitance and minimization approaches. **Low Power Design:** Voltage scaling, VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **Adders Design:** Standard Adder Cells, CMOS Adder's Architectures –Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders,	21
II	Low-Voltage Low-Power Design Techniques–Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles, **Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM, RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing.	21

Text books:

- CMOS Digital Integrated Circuits by Analysis and Design by Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
- Low-Voltage, Low-Power VLSI Subsystems by Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

References:

- Introduction to VLSI Systems: A logic, Circuit and System Perspective by Ming-BOLIN, CRC Press, 2011.
- Low Power CMOS Design by Anantha Chandrakasan, IEEE Press/ Wiely International, 1998.
- Low Power CMOS VLSi Circuit Design by Kaushik Roy, Sharat C Prasad, John Wuiely& Sons, 2000.

Course Outcomes: After successfully completion of the Course, student will able to:

CO 1:- Explain the various types of power dissipation and short channel effects.

CO 2- Analyze the performance of architectural approaches and scaling of CMOS integrated circuits with reference to speed and power dissipation.

CO 3:- Apply the power minimization techniques to reduce the power dissipation.

CO 4:-Design of SRAM cell for Low power applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC1007: INTELLIGENT SYSTEMS AND CONTROL

Course Objectives

- To provide students an opportunity to study the concepts of classical control design techniques like, P, PI and PID controllers.
- To provide students an opportunity to study the aspects of computational intelligence methods in depth to develop intelligent adaptive controllers.
- It focuses on designing intelligent controller using fuzzy logic, artificial neural networks and genetic algorithm techniques.
- It gives the analysis of learning systems in combination with feedback control systems, computer simulation of intelligent control systems to evaluate the performance.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Artificial Intelligence:** Introduction, Intelligence, Soft and Hard Computing, Artificial Intelligence. **Non-linear control:** Primer- Norms of signals, Vectors and matrices, Positive definite function, Positive definite matrices, Continuous time state model, Discrete time state space model, Lyapunov stability theory, Non Linear control strategies. **Genetic Algorithm**-Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. **Fuzzy Logic:** Classical sets, Fuzzy sets, Fuzzy rule base and approximate reasoning, Fuzzy logic control, System identification using T-S fuzzy models.	21
II	**Neural Networks:** Feed forward Networks, Multi-layered neural network, Redial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural networks. **Indirect adaptive control using neural networks:** Continuous time affine systems, Discrete-time affine system, Discrete-time Non-affine system, **Direct Adaptive Control using neural Networks:** Direct adaptive control single-input–single-output affine systems, Single-input-single output discrete time affine systems, Backstepping control. Neural network control of nonlinear discrete-time systems with actuator nonlinearities.	21

Text book:

- L. Behera, I. Kar, “Intelligent Systems & Control,” Second Edition, Oxford University Press
- J. Stuart. Russell & Peter Norvig, “Artificial Intelligence: A Modern Approach,” 1st Edition, Prentice Hall
- Simon Haykin, “Neural Networks: A Comprehensive Foundation,” 2nd Edition, Prentice Hall

Reference Book:

- Jagannathan Sarangapani, “Neural Network Control of Nonlinear Discrete time Systems,” Taylor & Francis

Course Outcomes: After successfully completing the course students will be able to

1. Understand the classical and fuzzy logic controllers for linear as well as nonlinear systems.
2. Apply the concept of meta-heuristic optimization algorithm like genetic algorithm for tuning of controller.
3. Analyze the stability and controllability of nonlinear systems.
4. Design an Artificial Neural Network for training and testing purpose of a system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3

MECC0800: SIGNAL PROCESSING LAB

Objectives: This course enables the students

1. To understand the practical use of digital signal processing in IIR and FIR filter design
2. To apply image transforms, edge detection, spatial domain and frequency domain filtering.
3. To simulate signal and image processing algorithms in MATLAB

Credits: 02 **L–T–P: 0–0–4**

Module	Section	Content	Teaching Hours
I	A	**Digital Signal Processing** • Implement the FIR Filters for 2 KHz cutoff frequency and 2 KHz bandwidth for band pass filter. • Design FIR filter using Fourier series expansion method. • Implement IIR low pass filter for a 4 KHz cutoff frequency and compare it the FIR filter with the same type use chirp as input signal. • Verify Blackman and Hamming windowing techniques for square wave as an input which window will give good results. • Generate DTMF sequence 1234567890*# and observe its spectrogram.	42
	B	**Digital Image Processing** • Write the program for finding the digital negative of the image. • Write the program to plotting the Histogram of image. • Write the program to find the edge of the image. • Design and Implementation of Spatial domain filters for image processing. • Design and Implementation of Frequency domain filters for image processing.	

Outcomes:

Students are able to learn

1. Implement the different signal and image processing techniques
2. Debug and simulate algorithms in MATLAB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

MECC0801: COMMUNICATION LAB

Objectives:

To verify the function of various advance communication techniques for different channel conditions.

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Teaching Hours
I	• Filtering of periodic signals • LTI system analysis in frequency domain • Bandpass to low pass transformation • Generation of samples of multivariate Gaussian process. • Power spectrum of random process and white process. • Linear filtering of random process • Low pass and band pass processes • Monte-carlo simulation of binary communication system • Optimum receiver for AWGN channels • Characterization of band limited channels and channel distortion • Characterization of Inter Symbol Interference. • Signal design for zero Inter Symbol Interference. • Implementation of matched filter. • Linear Equalizer • Nonlinear equalizer • Monte Carlo simulation of 16 QAM system	42

Outcomes: After the completion of the course, student will able to

CO 1: Implement perform signal processing related to communication.
CO 2: Design equalizer, matched filter corresponding to the communication signal.
CO 3: Analyze the performance of different subsystem used in communication.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO4 /PSO2, PSO3

MECC0802: HDL PROGRAMMING LAB

Objectives:

The objective of this Lab to provide hands on design experience with professional design (EDA) platforms of VLSI circuit in digital domain.

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Xilinx ISE Based Experiments:** • Synthesis and simulation of Full Adder/ Subtractor • Synthesis and simulation of Multiplexer/ Demultiplexer • Synthesis and Simulation of 3 X 8 Decoder. • Synthesis and Simulation of Encoder/ Priority Encoder. • Synthesis and simulation of 2 bit comparator. • Synthesis and simulation of Upcounter/ Downcounter • Synthesis and Simulation of Flip Flop (D, and T). • Shift Register/ Universal Shift Register • Synthesis and Simulation of Memory – ROM, RAM • Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out. • Array Multiplier/ Array Multiplier With Pipelining	24

Outcomes: *After completion of Lab, student will be able to:*

1. *Write HDL code for advanced digital integrated circuits.*
2. *Perform the Simulation and Analysis of Digital Blocks using EDA tools.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

Course Outcomes: After successfully completing the course students will be able to

1. Employ the digital design tools for HDL design entry, simulation and synthesis.
2. Create and verify functionality of various gates at the transistor level.
3. Demonstrate knowledge and understanding of fundamental concepts of CAD tools (XILINX and TANNER).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

MECC0006: LOW POWER VLSI DESIGN

Objectives:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent.
- Power dissipation mechanism in various MOS logic style.
- Identify suitable techniques to reduce the power dissipation.
- Design memory circuits with low power dissipation.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation **Short Channel Effects:** Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Switched Capacitance and minimization approaches. **Low Power Design:** Voltage scaling, VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **Adders Design:** Standard Adder Cells, CMOS Adder's Architectures –Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders,	21
II	Low-Voltage Low-Power Design Techniques–Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles, **Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM, RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing.	21

Text books:

- CMOS Digital Integrated Circuits by Analysis and Design by Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
- Low-Voltage, Low-Power VLSI Subsystems by Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

References:

- Introduction to VLSI Systems: A logic, Circuit and System Perspective by Ming-BOLIN, CRC Press, 2011.
- Low Power CMOS Design by Anantha Chandrakasan, IEEE Press/ Wiely International, 1998.
- Low Power CMOS VLSi Circuit Design by Kaushik Roy, Sharat C Prasad, John Wuiely& Sons, 2000.

Course Outcomes: After successfully completing the course students will be able to

1. The student will get to know the basics and advanced techniques in low power design which is a hot topic in todays market where the power plays major role.
2. The reduction in power dissipation by an IC earns a lot including reduction in size, cost and etc.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0007: INTELLIGENT SYSTEMS AND CONTROL

Objectives: The objective of this subject is to provide students an opportunity to study the aspects of computational intelligence methods in depth to develop intelligent adaptive controllers. In particular, this subject will focus on designing intelligent controller using fuzzy logic, artificial neural networks and genetic algorithm techniques. It will give the analysis of learning systems in combination with feedback control systems, computer simulation of intelligent control systems to evaluate the performance.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Artificial Intelligence:** Introduction, Intelligence, Soft and Hard Computing, Artificial Intelligence. **Non-linear control:** Primer- Norms of signals, Vectors and matrices, Positive definite function, Positive definite matrices, Continuous time state model, Discrete time state space model, Lyapunov stability theory, Non Linear control strategies. **Genetic Algorithm-**Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. **Fuzzy Logic:** Classical sets, Fuzzy sets, Fuzzy rule base and approximate reasoning, Fuzzy logic control, System identification using T-S fuzzy models.	22
II	**Neural Networks:** Feed forward Networks, Multi-layered neural network, Redial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural networks. **Indirect adaptive control using neural networks:** Continuous time affine systems, Discrete-time affine system, Discrete-time Non-affine system, **Direct Adaptive Control using neural Networks:** Direct adaptive control single-input–single-output affine systems, Single-input-single output discrete time affine systems, Backstepping control. Neural network control of nonlinear discrete-time systems with actuator nonlinearities.	21

Text book:

- L. Behera, I. Kar, "Intelligent Systems & Control," Second Edition, Oxford University Press
- J. Stuart. Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach," 1st Edition, Prentice Hall
- Simon Haykin, "Neural Networks: A Comprehensive Foundation," 2nd Edition, Prentice Hall

Reference Book:

- Jagannathan Sarangapani, "Neural Network Control of Nonlinear Discrete time Systems," Taylor & Francis
- Kevin Knight, Elaine Rich, B. Nair, "Artificial Intelligence," Third Edition, Mc Graw Hill Education India.

Course Outcomes: After successfully completing the course students will be able to

1. To understand about the computational intelligence methods like artificial neural networks, fuzzy systems and meta-heuristic algorithm.
2. Be able to apply the concepts fuzzy logic methods for designing intelligent controllers for nonlinear complex systems.
3. Be able to apply the concepts of neural networks for parameter estimation and designing intelligent controllers for nonlinear complex systems.
4. To apply meta-heuristic algorithms for controller tuning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0008: RF AND MICROWAVE TECHNIQUES

Objectives

To learn principles of the RF and microwave techniques, transmission line theory, Scattering parameters, design and analysis of commonly used passive and active components in RF and Microwave frequency range.

Credits: 04 L–T–P: 4–0–0

Module No.	Content	Teaching Hours
I	**Transmission Lines (TL)**: Introduction, Terminations of TLs, TL input impedance, time average power, Return and insertion losses, Voltage Standing Wave Ratio, The Smith chart and its applications **Impedance Matching and Tuning:** Transmission Line matching with lumped *L* Networks, Stub tuning, Quarter-wave transformer matching **Microwave Network Analysis:** S parameters and the Scattering matrix, Properties of S matrices, S parameters and time average power **Passive Components:** Properties of dividers and couplers, T-Junction power divider, Wilkinson power divider, Quadrature (90°) hybrid, The 180° hybrid	21
II	**Microwave Filters:** Microwave Filter design by insertion loss method, Scaling of low pass prototype filters, Filter transformations **Microwave Amplifier Design**: Two-port power gains, Amplifier Stability, Single-stage transistor amplifier: Design for maximum gain, Design for specific gain. **Frequency Multipliers, Oscillators and Mixers:** Frequency multipliers, RF oscillators, Microwave oscillators, Oscillator phase noise, Mixers: Mixer characteristics, Single ended mixer, Balanced mixer	21

Text book:

- David M. Pozar, "*Microwave Engineering*", Third Edition, Wiley India.

Reference Books:

- Reinhold Ludwig & Gene Bogdanov, **"** RF circuit design: theory and applications**"**, Prentice Hall, 2009
- Peter A. Rizzi, **"***Microwave engineering: passive circuits, Prentice Hall***",** 1988.
- Bharathi Bhat &Shiban K. Koul, "*Stripline-Like Transmission Lines For Microwave Integrated Circuits*", New Age International, 1989.

Course Outcomes: After successfully completing the course students will be able to

After successfully completing the course students will be able to

1. Analyze transmission line networks.
2. Understand S-parameters and network characterization techniques using S- parameters
3. Design Transmission Line matching networks using lumped L Networks, Stub tuning, Quarter-wave transformer matching.
4. Design of commonly used passive components as power dividers, directional couplers in RF and microwave frequencies.
5. Design microwave filter by insertion loss method.
6. Design of commonly used active components as microwave amplifiers, frequency multipliers, oscillators and mixers,

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO5	PO1,PO2, PO3, PO4 /PSO1, PSO2

MECC0802: HDL PROGRAMMING LAB

Objectives:

The objective of this Lab to provide hands on design experience with professional design (EDA) platforms of VLSI circuit in digital domain.

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Xilinx ISE Based Experiments:** • Synthesis and simulation of Full Adder/ Subtractor • Synthesis and simulation of Multiplexer/ Demultiplexer • Synthesis and Simulation of 3 X 8 Decoder. • Synthesis and Simulation of Encoder/ Priority Encoder. • Synthesis and simulation of 2 bit comparator. • Synthesis and simulation of Upcounter/ Downcounter • Synthesis and Simulation of Flip Flop (D, and T). • Shift Register/ Universal Shift Register • Synthesis and Simulation of Memory – ROM, RAM • Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out. • Array Multiplier/ Array Multiplier With Pipelining	24

Outcomes: *After completion of Lab, student will be able to:*

1. *Implement and simulate HDL code for advanced digital integrated circuits.*
2. *Analyze the combinational and sequential circuits using EDA tools.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

MECC0803: RF AND MICROWAVE DESIGN LAB

Objectives:

The objective of this Lab to provide hands on experience of design and analysis of passive and active devices commonly utilized in microwave subsystems

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Simulationand Analysis of the Transmission Line under Different Load Conditions • Simulation and Analysis of S parameter of the Given Network • Design and simulation of Impedance Matching Network • Design and simulation of Power Divider • Design and simulation of Directional Coupler • Design and simulation of Microwave Filter • Design and simulation of Microwave Amplifier • Design and simulation of Low Noise Amplifier • Design and simulation of Microwave Mixer • Design and simulation of Microwave Oscillator	

Outcomes: *After completion of Lab, student will be able to*

1. Simulate and analyse the transmission lines under different load conditions
2. Design and simulate the RF and microwave passive devices such as power divider, directional coupler and filter.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1, PO2, PO4 /PSO2, PSO3

MECE0001: EMBEDDED SYSTEMS

Objectives: The course intends to develop an understanding of the technologies behind the embedded computing systems and also provide overview of various Microcontrollers, Real time operating system and advanced architectures like ARM processor.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Embedded Systems** Overview of Embedded Systems, Classification of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Design Process in Embedded System. **Overview of Microcontroller:** Microcontroller and Embedded Processors, Overview of 8051 Microcontroller family: Architecture, Input/output Ports and Circuits, External Memory, Counters and Timers. The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits ad PSW Register, 8051 Register Banks **8051 Assembly language programming** 8051-Instruction set, addressing modes, accessing memory using various addressing modes, Arithmetic instructions and programs, Logical instructions, BCD and ASCII application programs, Single-bit instruction programming, Reading input pins vs. port Latch, Programming of 8051 Timers, Counter Programming . Time delay generations and calculations. 8051 interrupts, Programming of timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts, interrupt priority in the 8051.	21
II	**Interfacing with 8051:** Interfacing an LCD to the 8051, 8051 interfacing to ADC, Sensors, Interfacing a Stepper Motor, 8051 interfacing to the keyboard, Interfacing a DAC to the 8051. **PIC Microcontroller** Introduction: PIC microcontroller features, PIC Architecture, Program memory, Addressing Modes, Instruction set, Instruction Format, Byte-Oriented Instructions, Bit-Oriented Instructions, Literal Instructions, Control Instructions **Advanced Microcontrollers**: Only brief general architecture of AVR, and ARM microcontrollers. **Design, Development and Debugging Tools for Microcontroller based Systems:** Software tools like Cross assembler, compiler, debuggers, simulators and hardware tools like In-Circuit Emulators(ICE), Emulators, Logic Analyzers etc.	21

Text Books:

- Muhammad Ali Mazidi, Janice GillispieMazidi., "The 8051 Microcontroller and Embedded systems", Person Education, 2nd Edition, 2004.
- John.B.Peatman, "Design with Microcontrollers", Person Education, 1st Edition, 2004.

Reference Books:

- Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 2nd Edition, 2000.
- David E. Simon, “An Embedded Software Primer”, Pearson Education, 1999.
- V. Deshmukh, "Microcontrollers: theory and applications", Tata Mc Graw Hill, 12th reprint, 2005.

Course Outcomes: After successfully completing the course students will be able to

1. Can understand what is embedded systems and the embedded system design process.
2. Can understand the basic 8051 and PIC microcontrollers architecture and programming.
3. Can understand the various applications like blinking of LED Digital logic, Precision Analog and serial Communications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2

MECE0002: INFORMATION THEORY & CODING

Objectives: The course aims at providing students a foundation in information theory – the theory that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Information Theory :-**Concept of amount of information, entropy, marginal, conditional and joint entropies and relation among entropies mutual information, information rate, Source coding Kraft's inequality, coding efficiency and redundancy, Noiseless coding theorem **Construction of basic sourcecodes**: Shannon Fano Algorithm, Huffman coding, Channel capacity, redundancy and efficiency of a channel, binary symmetric channel (BSC), Binary error channel (BEC) capacity of band limited Gaussian channels, Shannon Hartley theorem, Bandwidth- SNR trade off, capacity of a channel of infinite bandwidth, Shannon's limit, Introduction to rings, fields, and Galois fields,	20
II	Codes for error detection and correction, parity check coding linear block codes error detecting and correcting capabilities generator and parity check matrices, standard array and syndrome decoding, perfect codes, Hamming codes encoding and decoding, cyclic codes polynomial and matrix descriptions generation of cyclic codes, decoding of cyclic codes, BCH codes description and decoding, Reed Solomon Codes, Burst error correction. Convolution Codes, Trellis diagrams, transfer function and minimum free distance, Maximum likelihood decoding of convolution code, the Viterbi algorithm, Sequential decoding, Cryptography, LDPC, Space time codes, Bar codes	22

Text book:

- R Bose, "*Information Theory, Coding and Cryptography*", TMH publication.

Reference Books:

- Das Mullick Chatterjee "*Principles of Digital communication"* Wiley Eastern Ltd.
- P.S. Sathya Narayana "*Concepts of Information Theory & Coding "*Dynaram Publications, 2005.

Outcomes:

1. Understand the basic notions of information and channel capacity.
2. Demonstrate different source and channel coding techniques including Huffman, Lampel-ziv, block codes, convolutional codes and decoding techniques, and automatic repeat request (ARQ) schemes.
3. Analyze the performance of coding techniques in communication and storage media.
4. Design practical coding and decoding techniques like RS, Turbo codes used in modern communication.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1, PO2, PO3, PO4 /PSO1, PSO2

MECE0003: APPLICATION SPECIFIC INTEGRATED CIRCUITS

Objectives: The course focuses on the semi-custom IC Design and introduces the principles of design logic cells, I/O cells and interconnects architecture, with equal importance given to FPGA and ASIC styles.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to ASICS, CMOS Logic and Library Design**: Types of ASICs, Design flow, CMOS transistors, CMOS Design rules, Combinational Logic Cell, Sequential logic cell, Data path logic cell, Transistors as Resistors, Transistor Parasitic Capacitance, Logical effort Library cell design, Library architecture . **Programmable ASICS, Logic Cell and I/Os:** Antifuse static RAM, EPROM and EEPROM technology, PREP benchmarks, Actel ACT, Xilinx LCA, Altera FLEX, Altera MAX DC & AC inputs and outputs - Clock & Power inputs, Xilinx LCA, Xilinx EPLD, Altera MAX 5000 and 7000, Altera MAX 9000, Altera FLEX .	21
II	**Logic Synthesis, Simulation and Testing** Design systems, Logic Synthesis, Half gate ASIC, Schematic entry, Low level design language, PLA tools -EDIF- CFI design representation. Verilog and logic synthesis, VHDL and logic synthesis, types of simulation, boundary scan test fault simulation, automatic test pattern generation. **ASIC Construction, Floor Planning, Placement and Routing** System partition, FPGA partitioning, partitioning methods, floor planning, placement, physical Design flow, global routing, detailed routing, special routing, and circuit extraction.	21

Text books:

- M.J.S. Smith, Application Specific Integrated Circuits, Addison -Wesley Longman Inc.1997.
- Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.

Reference Books:

- Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
- NekoogarF.. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR, 1999.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the design flow of different types of ASIC.
2. Apply the types of programming technologies and logic devices.
3. Implement design steps like partitioning, floor planning, placement and routing including circuit extraction of ASIC
4. Analyse the synthesis, Simulation and testing of systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECC0004: OPTIMAL CONTROL SYSTEM

Objectives:

- To have complete familiarity with Calculus of Variation.
- To understand different forms of performance measures as applied to variety of optimal control problems.
- To model linear quadratic regulator problem.
- To understand Pontryagin's minimum principle.
- To apply dynamic programming.
- To motivate students towards research work on the subject.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**OPTIMAL CONTROL PROBLEMS:** Statement of optimal control problem - Problem formulation and types of optimal control - Selection of performance measures, General Model of feedback control systems, Transient performance analysis, Tracking performance analysis, Disturbance rejection analysis, Cost functions and norms, Mathematical preliminary to optimal control. **CALCULUS OF VARIATION AND HAMILTON FORMULATION:** Fundamental concepts - Extremum functionals involving single and several independent functions – Piecewise smooth extremals - Variation of functionals with fixed and free terminal time constrained extrema Pontryagin's minimum principle - State inequality constraints - The Weierstrass Erdmann corner conditions - Solution of Bolza problem. Partial differential equation for cost function - Hamilton Jacobi equation - Principle of optimality, solution of Hamilton Jacobi equation - Matrix Riccati equation - Optimal control law. **LINEAR QUADRATIC CONTROL PROBLEMS:** Optimal control by Liapunov method - Parameter optimization – Quadratic performance index - Optimal control of systems - Matrix Riccati equation and solution methods of State regulator and discrete systems - Choice of weighting matrices – Linear Quadratic Guassian control – Kalman filter – H_2 and $H\infty$ Control and Optimal estimation.	24
II	**DYNAMIC PROGRAMMING:** Principle of optimality - Recurrence relation of dynamic programming for optimal control problem - Combinational procedure for solving optimal control problem. **DISCRETE TIME SYSTEMS:** Solution of general discrete optimization problem - Discrete time linear quadratic regulator - Suboptimal feedback - Regulator problem with functions of final state fixed. Time optimal and fuel optimal control problems - Minimum time control problem, Uniqueness of control - Bang bang control – Case study-Aero space applications-Fuel optimal systems.	21

Text Books:

- Kirk D E, "Optimal Control Theory: An Introduction", Prentice Hall, New Jersey, 2008.
- Brian D O Anderson and John B Moore, "Optimal Control - Linear Quadratic Methods", Prentice Hall of India, 1991.

Reference Books:

- Jeffrey B Burl, “Linear Optimal Control”, Addison-Wesley, California, 1999.
- Frank L Lewis, “Optimal Control”, John Wiley & Sons, New York, 1986.
- Gopal M, “Modern Control System Theory”, Wiley Eastern, New Delhi, second Edition, 1993.
- Michael Athens. “Optimal Control”, Tata McGraw Hill Publishing Company Ltd., 1996.

Course Outcomes: After successfully completing the course students will be able to

1. Apply knowledge of advanced principles to the analysis of electrical and computer engineering problems.
2. Apply the appropriate industry practices, emerging technologies, state-of- the-art design techniques, software tools, and research methods in the field optimal control.
3. Model the LQR problem.
4. Design the optimal controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0005: DIGITAL SATELLITE COMMUNICATION

Objectives: To introduce various aspects in the design of systems for satellite communication.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Communication Satellite**: Elements of satellite communication, orbit period & velocity, Effects of orbit inclination, Azimuth & elevation, Coverage angle & Slant range, Eclipse, Placement of satellite in geostationary orbit, Communication subsystem, Telemetry command & ranging subsystem, Attitude control subsystem, Electrical power subsystem. **Earth Station** : Earth station, Antenna ,Antenna types, Antenna gain, Antenna pointing loss, Effective isotopic radiated power, Antenna gain to noise temperature ratio, G/T measurement ,High power amplifier, Redundancy configurations, Carrier combining, Power combining, Low noise amplifier: Redundancy configurations, Nonlinearity, Up converter & down converter, Conversion process, Transponder hopping, Polarization hopping, **Satellite Link** : Basic link analysis, Interference analysis: Carrier to noise plus interference ratio, Cross polarization interference ,Adjacent channel interference, Intermodulation interference ,Intersymbol interference ,Rain induced attenuation, Prediction of attenuation. **Frequency Division Multiple Access** : FDM-FM-FDMA, Single channel per carrier, FM-FDMA television, Companded FDM-FM-FDMA & SSB-AM-FDMA, Intermodulation products resulting from both amplitude & phase nonlinearities, Optimized carrier to intermodulation plus noise ratio.	22
II	**Time Division Multiple Access:** TDMA frame structure, Reference burst, Traffic burst, Guard time, TDMA burst structure, Unique word, Signaling channel, Traffic data, TDMA frame efficiency, Frame acquisition and Synchronization, Satellite position determination **Demand assigned Multiple Access:** The Erlang B formula, Types of demand assignments ,DAMA characteristics, Real-time frame reconfiguration, Frame and burst structures for DA-TDMA,DAMA interfaces,SCPC-DAMA,SPADE,Digital speech interpolation. **Satellite Packet Communications:**Message transmission by FDMA, The M/G/1 queue, pure ALOHA, Satellite packet switching, Slotted ALOHA, Packet reservation, Tree algorithm. **Satellite Spread Spectrum Communications**: Direct sequence spread spectrum systems,PN sequence, Error rate performance in uniform jamming, Error rate performance in pulsed jamming, , Frequency hop spread spectrum systems, DS acquisition and synchronization,FH acquisition and synchronization, Satellite on-board processing **Very Small Aperture Networks :**VSAT technologies, Network configurations multi-access and networking, **Mobile satellite networks**: operating environment, MSAT network concept, CDMA MSAT network concept, statistics of mobile propagation	22

Text book:

- Tri T. Ha. "Digital Satellite Communications" Tata-McGraw-Hill.1990.

References:

- Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt "Satellite Communications" 2nd Ed. John Wiley & Sons.
- Dennis Roddy "Satellite Communications" 3rd Ed. Mc-Graw-Hill.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the elements of satellite & earth station of satellite communication.
2. Understand the orbital mechanics, multiple access techniques like FDMA, TDMA & CDMA, Packet Communication & spread spectrum communication
3. Explain the working of Very Small Aperture Terminals (VSAT), Mobile satellite networks
4. Design a satellite link.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0006 : ADVANCED DATA NETWORK

Objectives:

- To learn most prevalent IPv6 addressing & its issues.
- To know various neighbor finding algorithms used for data routing.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**An Overview-** Fast access technologies (ADSL, Cable Modem etc.) **IPv6-** Why IPv6.Protocol architecture, Address Architecture, Internet Control Message Protocol for IPv6. **Neighbor Discovery-** Conceptual model of host, Service from neighbor Discovery Protocol, Message Formats, options	21
II	**Address Auto Configuration-** Stateless and State-full Auto Configurations, Duplicate Address Detection (DAD), Opti- DAD, DHCPv6, Interconnection between IPv6 and IPv4. **Domain Name system- terminology,** DNS Architecture, Domain Name space, name Resolution, Packet Format, DNS extension, Requirement for DNS support in transition. Mobility support in IPv6, Enhanced handover Schemes for Mobile IPv6, Enhanced Handover Schemes for mobile IPv6, Security in Mobile IP	21

Reference Books:

- "*Understanding IPv6*", YoungsongMun, Hyewon k, Lee, Springer.

Course Outcomes: After successfully completing the course students will be able to

1. Acquired knowledge about several sub-protocols behind IPv6.
2. Learn algorithms based on neighbor finding for shortest & Congestion free route.
3. Got an overview about Domain Name System (DNS).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0007: SPEECH PROCESSING

Objectives:

- To provide the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
- To describe basic algorithms of speech analysis common to many applications.
- To give an overview of applications (recognition, synthesis, coding).

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Digital Models for the Speech Signal:** Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals **Time Domain Models For Speech Processing:** Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing. **Digital Representations of the Speech Waveform:** Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.	22
II	**Homomorphic Speech Processing:** Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder. **Linear Predictive Coding of Speech:** Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications. **Speech Enhancement:** Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation. **Speech Synthesis:** Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis.	22

Text Book:

L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals”, Pearson Education (Asia) Pte. Ltd., 2004.

Reference Books:

- D. O’Shaughnessy, “Speech Communications: Human and Machine”, Universities Press, 2001.
- L. R. Rabiner and B. Juang, “Fundamentals of Speech Recognition”, Pearson Education (Asia) Pte. Ltd., 2004.

- Z. Li and M.S. Drew, "Fundamentals of Multimedia", Pearson Education (Asia) Pte. Ltd., 2004.

Course Outcomes: After successfully completing the course students will be able to

1. Demonstrate the representation of the speech signals in time and discrete domain.
2. Apply the speech processing algorithm to enhance the quality of speech
3. Analyze the algorithm to recognize and synthesize the speech of speaker.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0008: CMOS RF INTEGRATED CIRCUITS

Objectives: To provide students with RF circuit fundamentals for designing key building blocks in a typical RF transceiver using CMOS technology.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Parallel and Series RLC Resonant Networks, Impedance matching and Maximum power transfer, L Match-Low pass and High pass , T and Pi-match networks, RF Concepts: Non-linearity, Time variant, Harmonics, Gain Compression, Desensitization and Blocking, Cross-modulation, Intermodulation, Two tone test, Noise in RF circuits, Noise figure, Cascaded noise Figure, Transmitter –Cartesian and Polar Representation, Homodyne and Heterodyne architecture, Transmitter design issues: PA Pulling, Emission mask, Adjacent Channel Power, Spurs, noise	21
II	Direct conversion Receiver, Issues-DC offset, LO Self mixing, Interference leakage, 1/f noise, LO Pulling, Even order distortion I/Q mismatch, Heterodyne Receiver, IF frequency selection, Tradeoffs, Issues-Image Problem, Half IF problem, Dual IF Topology, Image Reject Receivers-Hartley and Weaver Architectures, Low noise amplifier (LNA), LNA Topologies, Mixers, Two-port and Three port mixers, Gilbert Mixer, Sources of non-linearity and noise in Gilbert Mixers, , Oscillators , RC and LC oscillators , Cross-coupled LC Oscillators ,Power Amplifiers-Linear and Switching type Power Amplifiers	22

Text Books:

- RF Microelectronics by Behzad Razavi. Pearson, 2012.

Reference Books:

- The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2006.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the basic principle of RF design and its tradeoff.
2. Analyze the performance parameters of radio frequency circuits.
3. Classify different typical transceiver architectures.
4. Design typical blocks of RF transceivers, including standard matching circuits, low-noise amplifiers, mixers, power amplifiers and RF oscillators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0009: OPTOELECTRONIC DEVICES

Objectives:

- Describe fundamental and applied aspects of optoelectronic device physics and its applications to the design and operation of optical waveguide and electro optic modulators.
- Analyze optoelectronic device characteristics in detail using concepts from quantum mechanics and solid-state physics.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Optical wave guides** Integrated optic – Substrate materials for optical integrated circuits – Optical wave, guide modes – theory of planer wave guides – symmetric and symmetric slab wave guides – channel waveguides – strip loaded waveguides – losses in optical waveguides. Transverse couplers – prism couplers – Grating Tapered couplers – Fiber to waveguides couplers. **Electro optic modulators** Characteristics of switches and modulators – Electro optic effect – Single and dual channel wave guides – electro – optic modulator – Mach Zehnder type electro – optic modulator – Comparison of waveguides modulators.	21
II	**Acousto – Optic Modulator** Principle of acousto – optic effect – Raman – Nath type modulator – Bragg type deflectors and switches acousto – optic frequency shifters. **Magneto Optic Devices** Characteristics of magneto Optic effect – Non – reciprocal waveguides – Interaction between magnetic spin wave and Optic wave – Optical isolator – Optical isolator – Optical filter. **Non Linear Fiber Optics and Applications** Fiber non linar ties – Optical solutions – Non linear birefringence effects – Optical pulse compression – RF spectrum analyzer – Analog to digital converter – integrated optic Doppler velcimeterOpto electronic integrated circuits – Opto microwave applications.	22

Text books:

- R. G. hullsperger. Integrated Optics : Theory and Technology springer, verlag series, 1991.
- G. P. Agarwal, Non linear Optics, Academic Press, 1989.

Reference Books:

- J.wilson& J.F.B. Hawkes, Optoelectronics : An introduction Prentice hall Inter nations
- series, 1983.
- L. J. Pinsion. Electro optics, John Willy & sons, 1085.
- L. Sharupic. N. Tugliv, Optoelectronics, MIR Publicashers. 1987.

Course Outcomes: After successfully completing the course students will be able to

1. An understanding of state-of- the art optoelectronic technology.
2. Understand fundamental properties of light and operation principles of basic optical components.
3. An understanding of semiconductor material properties and semiconductor opto-electronic device physics.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2

MECE0010: VLSI TESTING & TESTABILITY

Objectives: This course covers introduction to the concepts and techniques of VLSI verification and testing. Details of test economy, fault modeling and simulation, defects, Automatic Test Pattern Generation (ATPG), design for testability and built-in self-test (BIST) also covered.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Fault modeling and simulation:** Physical Faults and their modeling; Stuck at Faults, Bridging Faults, Fault detection, Fault Equivalence, Fault Dominance, Fault Collapsing and Checkpoint Theorem; General fault simulation techniques serial, parallel, concurrent and deductive fault simulation, critical path tracing, statistical fault analysis. **Combinational Circuit Test Pattern Generation:** Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras ,ATPG for single stuck-at faults and multiple stuck-at faults **Sequential Circuit Testing and Scan Chains:** ATPG for Single-Clock Synchronous Circuits, Use of Nine-Valued Logic and Time-Frame Expansion Methods, Complexity of Sequential ATPG	22
II	**Scan Chain based Sequential Circuit Testing** Scan Cell Design, Design variations of Scan Chains, Sequential Testing based on Scan Chains, Overheads of Scan Design, Partial-Scan Design **Design for testability:** Ad-hoc design for testability- test points, oscillators and clocks, logical redundancy; Controllability and observability, boundary scan partial/ full scan, serial and non-serial scan; boundary scan standard; Compression techniques; **Memory BIST** March Test, BIST with MISR, Neighborhood Pattern Sensitive Fault Test, Transparent Memory BIST	21

Text book:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.

Reference Books:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.
- Bushnell and Agarwal, "*V. D. VLSI Testing*", Kluwer.
- Agarwal, V. D. and Seth, S. C. "*Test Generation For VLSI Chips*". IEEE computer society press.
- Hurst, S. L. "*VLSI Testing: Digital And Mixed Analog/Digital Techniques*". INSPEC/IEE, 1999.

Outcomes:

1. Identify the significance of testable design.
2. Understand the concept of yield and identify the parameters influencing the same.
3. Specify fabrication defects, errors and faults.
4. Implement combinational and sequential circuit test generation algorithms.
   Identify techniques to improve fault coverage.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0011: BIOMEDICAL SIGNAL PROCESSING

Objectives: Objective of this course is to make students familiar with different types of biomedical signals and their analysis.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Discrete and continuous Random variables, Probability distribution and density functions. Gaussian and Rayleigh density functions, Correlation between random variables. Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems. Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Hoffman coding, vector quantisation, DCT and the K L transform.	22
II	Cardiological Signal Processing: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia etection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis. Adaptive Noise Canceling: Principles of Adaptive Noise Canceling. Adaptive Noise Canceling with the LMS daptation Algorithm. Noise Canceling Method to Enhance ECG Monitoring. Fetal ECG Monitoring. Neurological Signal Processing: Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive(A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.	22

Text Book:

D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill, 2005

Reference Books:

- Biomedical Digital Signal Processing, Willis J.Tompkins, PHI,
- Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2001.

Course Outcomes: After successfully completing the course students will be able to

CO1: Understand techniques for various levels of processes in biomedical signal analysis.
CO2: Demonstrate appropriate algorithms according to nature of the signal and acquisition characteristics.
CO3: Apply biomedical signal processing algorithms using appropriate tools like MATLAB.

CO4: Develop contemporary algorithms to address complex problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0012: WIRELESS COMMUNICATION & NETWORKS

Objectives: To study about Wireless networks, protocol stack and standards, study about fundamentals of 3G Services, its protocols and applications and study about evolution of 4G Networks, its architecture and applications

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Overview of wireless Communications** -Roadmap of cellular communications, first, second ,third& fourth generations, satellite communications, mobile cellular networks, circuit/packet switching, roadmap for wireless networking, wireless Local area networks, wireless personal area networks, wireless metropolitan area networks, wireless regional area networks, adhoc wireless networks, open system interconnect (OSI) reference. **Channel & Propagation-** Propagation loss ,free space loss, planet earth loss model, Okumura-Hata model,COST-231-Hata model,COST-231-Walfisch-Ikegami model ,Indoor propagation models, Channel fading, Log-normal shadowing ,Rayleigh fading, Random frequency modulation, Ricean fading, Nakagami fading, Doppler fading, WSSUS model ,Propagation mechanisms, reflection, refraction , scattering, diffraction, atmospheric effects, troposheric effects, ionospheric effects, Channel sounding. **Cellular & Multiple user systems-**The cellular concept, cell panning, cell capacity, interference, power control, channel assignment, handoff, duplexing, FDD,TDD, multiple access, FDMA, TDMA.CDMA, OFDMA, SDMA, random multiple access, ALOHA, carrier sense multiple access, scheduling access, Erlang capacity in uplink, protocol design for wireless networks, layered protocol design, cross layer design.	22
II	**Diversity-**Diversity methods, combining multiple signals, selection diversity, maximum ratio combining, equal gain combining, switch diversity, optimum combining, transmit diversity, open loop & closed loop transmit diversity, multiuser diversity. **Channel Estimation & Equalization**-Channel estimation, adaptive & blind channel estimation, channel equalization, optimum sequence detection, linear equalizer, decision feedback equalizer, MLSE equalizer, Veterbi algorithm, frequency domain equalizer, blind equalizer, pre-coding. **Spread Spectrum Modulation-**Introduction, spreading sequences, gold sequences , Kasami sequences ,Walsh sequences, orthogonal variable spreading factor sequences barker sequences, complementary codes, direct sequence spread spectrum .DS-CDMA model ,conventional receiver ,Rake receiver ,synchronization in CDMA, power control ,soft handoff, multiuser detection ,serial/parallel interference cancellation, combination of linear MUD & nonlinear SIC,BER performance, uplink capacity, frequency-hopping spread spectrum ,error performance of FHSS,FHSS versus DSSS.	22

Text books:

- "*Wireless Communication Systems"* from RF subsystems to 4G enabling technologies by Ke-Lin Du &M.N.Swamy, Cambridge University press, 2010.
- "*Wireless Communication*", principles & practices, second edition by theodoreS.Rappaport, Prentice Hall of India.

Reference Books:

- "*Wireless Communication Systems"* from RF subsystems to 4G enabling technologies by Ke-Lin Du &M.N.Swamy, Cambridge University press, 2010.
- "*Wireless Communication*", principles & practices, second edition by theodoreS.Rappaport, Prentice Hall of India.
- "*Modern Wireless Communications"* by Simon Haykin& Michael Moher, Pearson education,2005.
- "*Wireless Communication*" by Andrea Goldsmith, Cambridge University press, 2005.
- "*Fundamentals of Wireless Communicatio"n*, *David TSE* and PramodViswanath, Cambridge University Press, 2005.

Course Outcomes: After successfully completing the course students will be able to

1. Conversant with the latest 3G/4G and Wi-MAX networks and its architecture.
2. Design and implement wireless network environment for any application using latest wireless protocols and standards.
3. Implement different type of applications for smart phones and mobile devices with latest network strategies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0013: CAD FOR VLSI CIRCUITS

Objectives:

- The design of all VLSI circuits is carried out by making extensive use Computer Aided Design (CAD) VLSI design tool.
- As part of the present introductory course the principles of operation of all the important modules that go into the construction of a complete VLSI CAD tool will be discussed.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**VLSI DESIGN METHODOLOGIES** Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization. **DESIGN RULES** Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms - partitioning	21
II	**FLOOR PLANNING** Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems -Area routing - channel routing - global routing - algorithms for global routing. **SIMULATION** Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation -Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis. **MODELLING AND SYNTHESIS** High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.	21

Text books:

- S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

Reference Books:

- N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

Course Outcomes: After successfully completing the course students will be able to

1. Use VLSI design automation tools.
2. Perform high-level synthesis.
3. Discuss floor-planning concepts.
4. Design algorithms for placement and partitioning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0014: MEMORY DESIGN AND TESTING

Objectives:

- Get complete knowledge regarding different types of memories and their architectural techniques of memories.
- Analyze different parameters that lead malfunctioning of memories.
- Design reliable memories with efficient architecture to improve processes times and power.
- Design memory circuits with low power dissipation.

L–T–P: 4–0–0

Credits: 04

Module No:	Content	Teaching Hours
I	Introduction to SRAM, SRAM Architecture, SRAM Design Issues and Challenges, SRAM Bit-cell Topologies, Design Metrics of SRAM Bit-cell, Standard 6T SRAM Bit-cell: An Overview, Other SRAM Bit-cell Stability Metrics, Bit-line Measurement Design Metrics, Dynamic Stability Analysis, Single-Ended SRAM Bit-cell Design, Single-Ended 6T SRAM (SE-SRAM) Bit-cell, Read Stability and Write Ability Margins, Performance and Power Dissipation,2-Port SRAM Bit-cell Design, 2-Port 6T SRAM Bit-cell, Reconfigured Read-Port of a 2-Port 6T Bit-cell, SRAM Process Variation Sensitivity,	23
II	SRAM Bitcell Design Using Unidirectional Devices. Tunneling Transistors Development of TFETs Behavioural Model, NBTI and Its Effect on SRAM, The Physics of Negative Bias Temperature Instability NBTI Model SRAM Bitcells Under NBTI Effect of NBTI Under Process Variation Dynamic Random Access Memories (DRAMs):DRAM Technology Development-CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Strucutures-BiCMOS DRAMs-Soft Error Failures in DRAMs-Advanced DRAM Designs and Architecture-Application Specific DRAMs. Memory Fault Modeling, Testing, And Memory Design For Testability And Fault Tolerance RAM Fault Modeling, Electrical Testing, Peusdo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault Modeling and Testing-Application Specific Memory Testing.	22

Text/ References books:

- Jawar Singh, Saraju P. Mohanty, Dhiraj K. Pradhan“Robust SRAM Designs and Analysis”by, ISBN 978-1-4614-0817-8, Springer New York Heidelberg Dordrecht London
- A.K Sharma, “ Semiconductor Memories Technology, Testing and Reliability”, IEEE Press.:
- Luecke Mize Care, “ Semiconductor Memory design & application”, Mc-Graw Hill.

Course Outcomes: After successfully completing the course students will be able to

1. Analysis the different types of RAM, ROM designs.
2. Analysis the different RAM and ROM architecture and interconnects.
3. Analysis about design and characterization technique.
4. Analysis of different memory testing and design for testability.
5. Identification of new developments in semiconductor memory design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE 0804 MEMORY CIRCUIT DESIGN LAB

Objectives:

- *To become familiar with Cadence Virtuoso tool.*
- *To simulate the basic SRAM circuits on Cadence.*

Credits: 01 **L–T–P-J: 0–0-2-0**

Module No.	Content	Teaching Hours
I	*Cadence Virtuoso tool*: **List of Experiments: -** 1. Study of MOS Characteristic and Characterization 2. Dynamic Characteristics of CMOS Inverters (Propagation Delay, Power Dissip 3. Schematic Entry/Simulation of 6T static random access memory cell. 4. Memory Cell Read/Write Operation 5. Memory Cell Read/Write power 6. Memory Cell Read/Write stability 7. Sense amplifier 8. Read/write decoder 9. Design of SRAM Cell for low power application	10

Outcomes: *After completion of Lab, student will be able to:*

3. *Draw the basic circuit and perform the analysis of simulated results.*
4. *Design a memory cell at cadence virtuoso tool.*

MECE 0805: CMOS RF INTEGRATED CIRCUITS LAB

Credits: 01 **L–T–P: 0–0–2**

Objective:

- To perform the experiment *design and simulate the key building blocks of a typical RF Transceiver system.*

Module	Content	Teaching Hours
I	Design and Simulation of Different type of impedance matching networks(L, T and Pi)	24
	Design and Simulation of Low Noise Amplifier.	
	Design and Simulation of RF Mixer	
	Design and Simulation of Voltage Controlled Oscillator (VCO)	
	Design and Simulation of Power Amplifier	

Outcomes: After successful completion of this course, student are able todesign and simulate

CO 1: Design and simulate L, Pi and T type impedance matching networks using high frequency simulation software environment including ADS, Cadence virtuoso

CO 2: Analyze the performance in terms of matching, linearity, noise of Low noise amplifiers, Mixer, Voltage Controlled Oscillator, Phase locked loop and power amplifiers using high frequency simulation software environment including ADS, Cadence virtuoso.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO2	PO1,PO2, PO3, PO4, PO5 /PSO1, PSO2, PSO3