Course Structure for M.Tech. (CE & SP) Under the Regulations of SITE-21

Semester I (First year)

S.No.	Category	Course Code	Name of the Subject	L	T	P	C
1	CE	21ECSP101	Advanced Digital Signal Processing	3	0	0	3
2	CE	21ECSP102	Coding Theory & Applications	3	0	0	3
Elective-I							
3	PE	21ECSP103A	DSP Architectures	3	0	0	3
		21ECSP103B	Statistical Signal Processing	3	0	0	
		21ECSP103C	Radar signal processing	3	0	0	
Elective-II							
4	PE	21ECSP104A	Digital data communications	3	0	0	3
		21ECSP104B	Wireless Sensor Networks	3	0	0	
		21ECSP104C	Multimedia over communication	3	0	0	
5	MC	21ECSP105	Research methodology and IPR	2	0	0	2
6	CE	21ECSP151	Advanced Digital Signal Processing Lab	0	0	4	2
7	CE	21ECSP152	Data communications lab	0	0	4	2
8	AUD	21ECSP106	Audit course 1	2	0	0	-
			Total Credits				**18**

Semester II (First year)

S.No.	Category	Course Code	Name of the Subject	L	T	P	C
1	CE	21ECSP201	Antenna theory & Design	3	0	0	3
2	CE	21ECSP202	Image processing & machine vision	3	0	0	3
Elective-I							
3	PE	21ECSP203A	Internet of things	3	0	0	3
		21ECSP203B	Adaptive Signal processing	3	0	0	
		21ECSP203C	Biomedical Signal Processing	3	0	0	
Elective-II							
4	PE	21ECSP204A	Optical Networks	3	0	0	3
		21ECSP204B	Modern Spectrum Analysis & Estimation	3	0	0	
		21ECSP204C	EMI/EMC	3	0	0	0
5	CE	21ECSP251	Digital image &Video processing Lab	0	0	3	2
6	CE	21ECSP252	Detection and Estimation Theory Lab	0	0	3	2
7	MP	21ECSP253	Mini Project	0	0	0	2
8	AUD 2	21ECSP206	Audit course	2	0	0	0
			Total Credits				**18**

Semester III (Second year)

S.No.	Category	Course Code	Name of the Subject	L	T	P	C
1	PE	1ECSP301A	Mobile computing technologies	3	0	-	3
		21ECSP301B	Soft Computing Techniques	3	0	-	-
		21ECSP301C	Pattern Recognition & Machine Learning	3	0	-	-
2	OE	21ECSP302A	Optimization Techniques	3	0	-	3
		21ECSP302B	Modeling and Simulation Techniques	3	0	-	
		21ECSP302C	Artificial Intelligence	3	0	-	
3	Dissertation	21ECSP351	Dissertation Phase -I /Industrial Project (to be continued and evaluated next semester)	-	0	20	10
Total Credits							**16**

Semester IV (Second year)

S.No	Category	Course Code	Name of the Subject	L	T	P	C
1	Dissertation Project/ Dissertation Phase	21ECVE451	Project/ Dissertation Phase-II	0	0	0	16
Total Credits							**16**

ADVANCED DIGITAL SIGNAL PROCESSING

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP101	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

- At the completion of this course, the student should have in depth knowledge of processing digital signals.
- To study about discrete time systems and to learn about FFT algorithms.
- To study the design techniques for FIR and IIR digital filters
- To study the finite word length effects in signal processing
- To study the properties of random signal, Multirate digital signal processing and about QMF filters

Unit -1	**Teaching Hours**
Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.	**2 Hours**
Unit -2	
Multi rate DSP, Decimators and Interpolators, Sampling rate conversion,multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding.	**12 Hours**
Unit -3	
Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.	**10 Hours**
Unit -4	
Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm. Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum- Variance Spectral Estimation, Eigen analysis Algorithms for SpectrumEstimation. .	**08 Hours**
Unit -5	
Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications	**08 Hours**

Course outcomes:

After studying this course, students will be able to:

- At the end of this course, students will be able to
- To understand theory of different filters and algorithms
- To understand theory of multirate DSP, solve numerical problems and write algorithms
- To understand theory of prediction and solution of normal equations
- To know applications of DSP at block level

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall,2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd,1999

Reference Books:

1. Bruce W. Suter, "Multirateand Wavelet Signal Processing",1st Edition, Academic Press,1997.
2. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & SonsInc.,2002.
3. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall,2001.
4. D.G. Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing",McGraw Hill,2000.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	1	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

CODING THEORY AND APPLICATIONS

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP102	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Compare Block codes such as Linear Block Codes, Cyclic codes etc and Convolutional codes.
- Detect and correct errors for different data communication and storage systems.
- Implement different Block code encoders and decoders.
- Analyze and implement convolutional encoders and decoders.
- Analyze and apply soft and hard Viterbi algorithm for decoding of convolutional codes.

Unit -1	**Teaching Hours**
Coding for Reliable Digital Transmission and Storage: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies. **Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system	**12 Hours**
Unit -2	
Cyclic Codes: Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.	**12 Hours**
Unit -3	
Convolutional Codes: Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.	**10 Hours**
Unit -4	
Burst –Error-Correcting Codes: Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst- Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes, Phased-Burst –Error-Correcting Cyclic and Convolutional codes. .	**08 Hours**
Unit -5	

BCH – Codes: BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction	**08 Hours**

Course outcomes:

On completion of this course student will be able to

- Learning the measurement of information and errors.
- Obtain knowledge in designing Linear Block Codes and Cyclic codes.
- Construct tree and trellies diagrams for convolution codes
- Design the Turbo codes and Space time codes and also their applications

Question paper pattern:

5. It will have 5 questions.
6. Each full question carries 12 marks.
7. Each full question will have sub questions of internal choice type covering all topics under the unit.
8. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, PrenticeHall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.

Reference Books:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5th Ed., 2008, TMH.
3. Introduction to Error Control Codes-Salvatore Gravano-oxford
4. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon, 2006,Wiley India.
5. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Ed, 2009, TMH.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	1	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

DSP Architectures Effective from the academic year 2021-2022 SEMESTER – I			
Subject Code	21ECSP103A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Course objectives: To understand

- Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)
- Various Programmable Digital Signal Processors
- Interfacing Memory and I/O Peripherals to Programmable DSP Devices

Unit -1	**Teaching Hours**
Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. **Computational Accuracy in DSP Implementations:** Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.	**10 Hours**
Unit -2	
Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.	**10 Hours**
Unit -3	
Programmable Digital Signal Processors: Commercial Digital signal processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.	**10 Hours**
Unit -4	
Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.	**10 Hours**
Unit -5	
Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Understand Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)
- Understand architecture of Digital signal processor
- Explain Various Programmable Digital Signal Processors
- Understand Analog Devices Family of DSP Devices
- Interfacing Memory and I/O Peripherals to Programmable DSP Devices

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran,Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B.Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand &Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The ApplicationsEngineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith,Ph.D., California Technical Publishing, ISBN 0- 9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes , ISBN 0750679123, 2005

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	1	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

STATISTICAL SIGNAL PROCESSING

Effective from the academic year 2021 -2022

SEMESTER – I

Subject Code	21ECSP103B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Understand statistical models and characterization for signals
- Explain various nonparametric methods for estimation
- Understand filtering techniques like wiener and kalman

Unit -1	**Teaching Hours**
Signal models and characterization: Types and properties of statistical models for signals and how they relate to signal processing, Common second-order methods of characterizing signals including autocorrelation, partial correlation, cross-correlation, power spectral density and cross-power spectral density.	**10 Hours**
Unit -2	
Spectral estimation: Nonparametric methods for estimation of power spectral density, autocorrelation, cross-correlation, transfer functions, and coherence form finite signal samples.	**10 Hours**
Unit -3	
Review of signal processing: A review on random processes, A review on filtering random processes, Examples. **Statistical parameter estimation**: Maximum likehood estimation, maximum a posterior estimation, Cramer-Rao bound.	**10 Hours**
Unit -4	
Eigen structure based frequency estimation: Pisarenko, MUSIC, ESPRIT their application sensor array direction finding. **Spectrum estimation**: Moving average (MA), Auto Regressive (AR), Auto Regressive Moving Average (ARMA), Various non-parametirc approaches.	**10 Hours**
Unit -5	
Wiener filtering: The finite impulse case, causal and non-causal infinite impulse responses cases, Least mean squares adaptation, recursive least squares adaptation, Kalman filtering.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Understand statistical models and characterization for signals
- Explain various nonparametric methods for estimation
- Explain statistical parameter estimation techniques
- Understand Eigen structure based frequency estimation
- Understand filtering techniques like wiener and kalman

Question paper pattern:

1. It will have 5 questions.

2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Steven M.Kay, fundamentals of statistical signal processing: estimation Theory, Pretice-Hall,1993.
2. Monsoon H. Hayes, Stastical digital signal processing and modeling, USA, Wiley,1996.

Reference Books:

1. Dimitris G.Manolakis, Vinay K. Ingle, and Stephen M. Kogon, Statistical and adaptive signal processing, Artech House, Inc,2005, ISBN 1580536107

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

RADAR SIGNAL PROCESSING

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP103C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

The primary objective of this course is to:

- Understand radar principle and different types of radars
- Explain how to detect radar signals in noise
- Understand pulse compression techniques

Unit -1	**Teaching Hours**
Introduction: Radar Block Diagram, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar. Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.	**10 Hours**
Unit -2	
Detection of Radar Signals in Noise: Detection Criteria – Neyman- Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors – Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection – CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management – Schematics, Component Parts, Resources and Constraints.	**10 Hours**
Unit -3	
Waveform Selection [3, 2]: Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise Like Waveforms, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.	**10 Hours**
Unit -4	
Pulse Compression in Radar Signals: Introduction, Significance, Types, Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.	**10 Hours**
Unit -5	
Phase Coding Techniques: Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar. **Poly Phase Codes :** Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM), Sidelobe Reduction for Phase Coded PC Signals.	**10 Hours**

Course outcomes:

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

- Understand radar principle and different types of radars
- Explain how to detect radar signals in noise environment
- Understand Principles and Properties of Radar Ambiguity Function
- Understand pulse compression techniques
- Explain principles and techniques of phase coding

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Radar Handbook - M.I. Skolnik, 2nd Ed., 1991, McGraw Hill.
2. Radar Design Principles : Signal Processing and The Environment - Fred E. Nathanson,2nd Ed., 1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rd Ed., 2001, TMH.

Reference Books:

1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.
3. Radar Design Principles - F.E. Nathanson, 1st Ed., 1969, McGraw Hill.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	0	0	1	0	0	0	0	0	0	3
CO2	3	2	0	0	1	0	0	0	0	0	0	3
CO3	3	2	0	0	1	0	0	0	0	0	0	3
CO4	3	2	0	0	1	0	0	0	0	0	0	3
CO5	3	2	0	0	1	0	0	0	0	0	0	3

DIGITAL DATA COMMUNICATIONS

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP104A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: To understand

- Different modulation techniques to improve the bandwidth and their properties.
- Networking and different protocol systems.
- Error estimation and correction, asynchronous and synchronous protocols.
- Multiplexing techniques, different networking connections and interfacing devices.
- Multiple access techniques and analysis.

Unit -1	**Teaching Hours**
Digital Modulation Schemes: BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery	**10 Hours**
Unit -2	
Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Networks, Protocols and Standards, UART, USB, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks – TCP/IP Protocol suite and Comparison with OSI model.	**10 Hours**
Unit -3	
Error Correction: Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming codeData Link Control: Line Discipline, Flow Control, Error Control Data Link Protocols: Asynchronous Protocols, Synchronous Protocols, Character Oriented Protocols, Bit-Oriented Protocol, Link Access Procedures.	**10 Hours**
Unit -4	
Multiplexing: Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Multiplexing Application, DSL. **Local Area Networks:** Ethernet, Other Ether Networks, Token Bus, Token Ring, FDDI. Metropolitan Area Networks: IEEE 802.6, SMDS **Switching:** Circuit Switching, Packet Switching, Message Switching. Networking and Interfacing Devices: Repeaters, Bridges, Routers, Gateway, Other Devices.	**10 Hours**
Unit -5	
Multiple Access Techniques: Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), OFDM and OFDMA. Random Access, Aloha- Carrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Avoidance(CSMA/CA), Controlled Access-	**10 Hours**

Reservation- Polling- Token Passing, Channelization	

Course outcomes:

After studying this course, students will be able to:

- optimal Model digital communication system using appropriate mathematical techniques (error probability, constellation diagrams, pharos diagrams).
- Understanding the basic concepts of how digital data is transferred across computer networks.
- Independently understand basic computer network technology.
- Understand and explain Data Communications System and its components.
- Identify the different types of network topologies and protocols.
- Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Data Communication and Computer Networking - B. A.Forouzan, 2nd Ed., 2003, TMH.

2. Advanced Electronic Communication Systems - W. Tomasi, 5th Ed., 2008, PEI.

Reference Books:

1. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
2. Data and Computer Communications - William Stallings, 8th Ed., 2007, PHI.
3. Data Communication and Tele Processing Systems -T. Housely, 2nd Ed, 2008, BSP.
4. Data Communications and Computer Networks- Brijendra Singh, 2nd Ed., 2005, PHI.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

WIRELESS SENSOR NETWORKS

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP104B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: To understand

- Different modulation techniques to improve the bandwidth and their properties.
- Networking and different protocol systems.
- Error estimation and correction, asynchronous and synchronous protocols.
- Multiplexing techniques, different networking connections and interfacing devices.
- Multiple access techniques and analysis.

Unit -1	**Teaching Hours**
Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details	**10 Hours**
Unit -2	
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.	**10 Hours**
Unit -3	
Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)	**10 Hours**
Unit -4	
Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.	**10 Hours**
Unit -5	

Data dissemination and processing; differences compared with other database management systems, data storage; query processing. Specialized features: Energy preservation and efficiency; security challenges; fault- tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- optimal Model digital communication system using appropriate mathematical techniques (error probability, constellation diagrams, pharos diagrams).
- Understanding the basic concepts of how digital data is transferred across computer networks.
- Independently understand basic computer network technology.
- Understand and explain Data Communications System and its components.
- Identify the different types of network topologies and protocols.
- Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.

Question paper pattern:

5. It will have 5 questions.
6. Each full question carries 12 marks.
7. Each full question will have sub questions of internal choice type covering all topics under the unit.
8. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

3. Data Communication and Computer Networking - B. A.Forouzan, 2nd Ed., 2003, TMH.

4. Advanced Electronic Communication Systems - W. Tomasi, 5th Ed., 2008, PEI.

Reference Books:

5. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
6. Data and Computer Communications - William Stallings, 8th Ed., 2007, PHI.
7. Data Communication and Tele Processing Systems -T. Housely, 2nd Ed, 2008, BSP.
8. Data Communications and Computer Networks- Brijendra Singh, 2nd Ed., 2005, PHI.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

MULTI MEDIA OVER COMMUNICATION

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP104C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Understand statistical multimedia information representation and networks
- Explain various MPEG standards
  Understand synchronization and management tchniques

Unit -1	**Teaching Hours**
Multimedia Communications: multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.	**10 Hours**
Unit -2	
Information Representation: text, images, audio and video, Text and image compression, compression principles, text compression, image compression. Audio and video compression, audio compression, video compression, video compression principles, video compression standards: H.261, H.263, P1.323,MPEG 1, MPEG 2, Other coding formats for text, speech, image and video	**10 Hours**
Unit -3	
Detailed Study of MPEG 4: coding of audiovisual objects, MPEG 4 systems, MPEG 4 audio and video, profiles and levels. MPEG 7 standardization processof multimedia content description, MPEG 21 multimedia framework, Significant features of JPEG 2000, MPEG 4 transport across the Internet.	**10 Hours**
Unit -4	
Synchronization: Notion of synchronization, presentation Requirements, reference model for synchronization, Synchronization specification. Multimedia operating systems, Resource management, process management techniques.	**10 Hours**
Unit -5	
Multimedia Communication Across Networks: Layered video coding, errorresilient video coding techniques, multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, multimedia in mobilenetworks, multimedia in broadcast networks.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Understand statistical multimedia information representation and networks
- Explain various MPEG standards
- Understand synchronization and management techniques
- Understand network protocols for multimedia communicationUnderstand and explain Data Communications System and its components.

Question paper pattern:

9. It will have 5 questions.
10. Each full question carries 12 marks.
11. Each full question will have sub questions of internal choice type covering all topics under the unit.
12. The student will have to answer all 5 full questions with the opted choice in eachquestion.

Text Books:

5. Fred Halsall, "Multimedia Communications", Pearson education, 2001

6. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004

Reference Books:

9. Raif steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002
10. John Billamil, Louis Molina, "Multimedia : An Introduction", PHI, 2002

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

RESEARCH METHODOLOGY & IPR

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	code	**IA Marks**	40
Number of Lecture Hours/Week	02	**Exam Marks**	60
Total Number of Lecture Hours	47	**Exam Hours**	03

Credits – 02

Course objectives:

The course objective is to make students to learn the basic concepts of research methodology and intellectual property rights

Unit -1	**Teaching Hours**
meaning of research problem, sources of research problem ,criteria characteristics of a good research Scope and objectives of Research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations .	**10 Hours**
Unit -2	
Effective literature studies approaches, analysis Plagiarism, Research ethics. Effective technicalwriting, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	**8 Hours**
Unit -3	
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT. .	**10 Hours**
Unit -4	
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patentinformation and databases. Geographical Indications.	**10 Hours**
Unit -5	
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	**9 Hours**

Course outcomes:

At the end of this course, students will be able to

1.Understand research problem formulation.
2.Analyze research related information
3.Follow research ethics
4.Understand that today‟s world is controlled by Computer, Information Technology, buttomorrow world will be ruled by ideas, concept, and creativity.
5.Understanding that when IPR would take such important place in growth of individuals & nation,it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Question paper pattern:

1.It will have 5 questions.
2.Each full question carries 12 marks.
3.Each full question will have sub questions of internal choice type covering all topics under the unit.
4.The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1.Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students‟
2.Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3.Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007

Reference Books:

1.Mayall , Industrial Design", McGraw Hill, 1992.
2.Niebel , "Product Design", McGraw Hill, 1974.
3.Asimov , "Introduction to Design", Prentice Hall, 1962.
4.Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
5.T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	0	0	0	0	0	3
CO2	3	2	1	1	2	1	0	0	0	0	0	3
CO3	3	2	1	1	2	1	0	0	0	0	0	3
CO4	3	2	1	1	3	1	0	0	0	0	0	3
CO5	3	2	1	1	2	1	0	0	0	0	0	3

ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP151	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	48	**Exam Hours**	03

Credits – 02

Course objectives: This course will enable students to:

- Verify generation of various signals and operations on signals
- Practically visualize autocorrelation, power spectrum estimation and other concepts in DSP
- Enhance programming skills in signal processing field.

Experiments

A. Minimum of 10 Experiments have to be conducted

B. All Experiments may be Simulated using MATLAB and to be verified theoretically.

1. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
2. Program to verify Decimation and Interpolation of a given Sequences.
3. Program to Convert CD data into DVD data
4. Generation of Dual Tone Multiple Frequency (DTMF) Signals
5. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods
6. Estimation of Power Spectrum using Bartlett and Welch methods
7. Verification of Autocorrelation Theorem
8. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation
9. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal
10. Design of LPC filter using Levinson-Durbin Algorithm
11. Computation of Reflection Coefficients using Schur Algorithm
12. To study Finite Length Effects using Simulink
13. Design and verification of Matched filter
14. Adaptive Noise Cancellation using Simulink
15. Design and Simulation of Notch Filter to remove 60Hz Hum/any unwanted frequency component of given Signal (Speech/ECG)

Course outcomes: The student will be able to demonstrate

- generation of various signals and operations on signals
- Practical visualization of autocorrelation, power spectrum estimation and other concepts in DSP
- Programming skills in signal processing field.

Conduct of Practical Examination:

1. Ten questions will be given and student should choose one question (blind option) carries 50 marks in total.
2. (a) 40 marks will be allotted for write-up, execution and result.
   (b) 10 marks will be allotted for viva voce.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	0	0	3	0	0	0	0	0	0	1
CO2	3	2	0	0	3	0	0	0	0	0	0	1
CO3	3	2	0	0	3	0	0	0	0	0	0	1

DATA COMMUNICATIONS LABORATORY

Effective from the academic year 2021-2022

SEMESTER – I

Subject Code	21ECSP152	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	48	**Exam Hours**	03

Credits – 02

Course objectives: This course will enable students to:

- Verify generation of various signals and operations on signals
- Practically visualize autocorrelation, power spectrum estimation and other concepts in DSP
- Enhance programming skills in signal processing field.

List of Experiments:

1. Study of serial interface RS – 232
2. Study of pc to pc communication using parallel port
3. To establish pc-pc communication using LAN
4. Study of LAN using star topology, bus topology and tree topology
5. Study and configure modem of a computer
6. To configure a hub/switch
7. To study the interconnections of cables for data communication
8. Study of a wireless communication system
9. Set up of time division multiplexing using fiber optics
10. Digital Fiber Optical Transmitter and Receiver

Course outcomes: The student will be able to

- Study Serial interface RS-232
- ESTABLISH PC-PC communication
- Programming skills in communication field

Conduct of Practical Examination:

3. Ten questions will be given and student should choose one question (blind option) carries 50 marks in total.
4. (a) 40 marks will be allotted for write-up, execution and result.
   (b) 10 marks will be allotted for viva voce.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO2	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO3	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

ANTENNA THEORY AND DESIGN

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	18ECSP201	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Understand parameters of antennas
- Explain the concept linear array and planar array
- Design antennas using various Antenna Synthesis techniques
- Understand various computational methods

Unit -1	**Teaching Hours**
Antenna fundamental and definitions: Radiation mechanism - overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization. Resonant Antennas: Wires and patches, Dipole antenna, Yagi-Uda antennas, Microstrip antenna.	**10 Hours**
Unit -2	
Antenna Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.	**10 Hours**
Unit -3	
Broadband antennas: Travelling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas. **Aperture antennas:** Techniques for evaluating gain, Reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, FiECS representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.	**10 Hours**
Unit -4	
Antenna Synthesis: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low sidelobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method.	**10 Hours**

Unit -5	
Method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.	**10 Hours**
Computational EM: FTTD methods, Geometrical optics, Wedge diffraction theory, Ray fixed coordinate system, Uniform theory of wedge diffraction, E--plane analysis of horn antennas. Cylindrical parabolic antennas, Radiation by a slot on a finite ground plane, Radiation by a monopole on a finite ground plane, Equivalent current concepts, Multiple diffraction formulation by a curved surfaces, Physical optics, Methods of stationary phase, physical theory of diffraction, Cylindrical parabolic reflector antennas.	

Course outcomes:

After studying this course, students will be able to:

- Understand parameters of antennas
- Explain the concept linear array and planar array
- Explain radiation characteristics of various broadband antennas
- Design antennas using various Antenna Synthesis techniques
- Understand various computational methods

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. C. A. Balanis, **"Antenna Theory Analysis and Design"**, John Wiley, 2nd edition, 1997.
2. J. D. Kraus, **"Antennas"**, McGraw Hill TMH, 3rd/4th edition.

Reference Books:

1. Stutman and Thiele, **"Antenna theory and design"**, 2nd edition John Wiley and sons Inc.
2. Sachidnanda et al, **"Antennas and propagation"**, Pearson Education.
3. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi, 2001.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

IMAGE PROCESSING & MACHINE VISION

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	18ECSP202	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: This course provides

- An introduction to image analysis and computer vision for undergraduates.
- An introduction to low-level vision (early processing) techniques such as binaryimage analysis, filtering, edge detection and texture analysis.
- An introduction to mid-level vision topics such as image segmentation and feature extraction.
- Application of Image processing techniques to image retrieval, image classification, and object recognition with emphasis on feature extraction and image representations for recognition.

Unit -1	**Teaching Hours**
The image mathematical and physical background: Linearity, The Dirac distribution and convolution, Linear integral transforms, Images as linear systems, **Introduction to linear integral transforms:** 2D Fourier transform, Sampling and the Shannon constraint, Discrete cosine transform, Wavelet transform, Eigen-analysis, Singular value decomposition Principal component analysis, Other orthogonal image transforms, Images as stochastic processes	**10 Hours**
Unit -2	
Image pre-processing: Scale in image processing, Canny edge detection, Parametric edge models, Edges in multi-spectral images, Pre-processing in frequency domain, Line detection, Corner detection, Maximally stable extremal regions, **Image restoration**: Degradations that are easy to restore, Inverse filtration, Wiener filtration	**10 Hours**
Unit -3	
Image segmentation: Threshold detection methods, Optimal thresholding , Multi-spectral thresholding , Edge-based segmentation, Edge image thresholding, Edge relaxation, Border tracing, Border detection as graph searching, Border detection as dynamic programming, Hough transforms, Border detection using border location information, Region construction from borders, Region-based segmentation, Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing post-processing. **Matching :** Matching criteria, Control strategies of matching **Evaluation issues in segmentation:** Supervised evaluation, Unsupervised evaluation	**10 Hours**
Unit -4	
Advanced segmentation: Mean Shift Segmentation, Active contour models-snakes, Traditional snakes	**10 Hours**

and balloons, Extensions, Gradient vector flow snakes, Geometric deformable models-level sets and geodesic active contours, Fuzzy Connectivity, **Contour-based shape representation and description:** Chain codes, Simple geometric border representation, Fourier transforms of boundaries, Boundary description using segment sequences, B-spline representation, Other contour-based shape description approaches, Shape invariants.	
Unit -5	
Knowledge representation: Statistical pattern recognition, Classification principles, Classifier setting, Classifier learning, Support Vector Machines, Cluster analysis **Neural nets:** Feed-forward networks, Unsupervised learning, Hopfield neural nets **Optimization techniques in recognition:** Genetic algorithms, Simulated annealing **Fuzzy systems:** Fuzzy sets and fuzzy membership functions, Fuzzy set operators, Fuzzy reasoning, Fuzzy system design and training	**10 Hours**

Course outcomes:

- Students will be able to apply techniques for image enhancement, segmentation and filtering.
- Students will be able to process and analyze image data.
- Students will be able to implement a complete image-processing package using standard concepts.
- Students will be able to understand advanced segmentation techniques
- Students will be able to decide on a suitable learning/ recognition technique for a problem in hand using standard concepts.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Milan Sonka, Vaclav Hlavac , Roger Boyle**" Image Processing, Analysis, and Machine Vision",** Cengage Learning, 2014 or 3rd Edition, 2008ISBN:049508252X

Reference Books:

1) Scott.E.Umbaugh,**"Computer Vision and Image Processing"**,PrenticeHall, 1997.
2) A. K.Jain,**" Fundamentals of Digital Image Processing"**,Pearson, 2004.
3) S.Jayaraman, S . Esakkirajan, T. Veera kumar, **"Digital Image Processing "**, Tata McGraw Hill, 2004.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	0	0	1	0	0	0	0	0	0	3
CO2	3	2	0	0	1	0	0	0	0	0	0	3
CO3	3	2	0	0	1	0	0	0	0	0	0	3
CO4	3	2	0	0	1	0	0	0	0	0	0	3
CO5	3	2	0	0	1	0	0	0	0	0	0	3

INTERNET OF THINGS
(Elective)
Elective from the academic year 2021 -2022
SEMESTER - II

Subject Code	21ECSP203A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	40	**Exam Hours**	03

Credits - 03

Course objectives:
The course objective is to make students describe and design the IoT based applications

Unit -1	**Teaching Hours**
Introduction-What is The Internet of Things? Overview and Motivations, Examples of Apllications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication ExamplesOverview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications	**10 Hours**
IoT Technologies- Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT StandardsOverview and Approaches,IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol,Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Lowpower WPAN, Zigbee IP(ZIP),IPSO	**9 Hours**
Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity :IPv6 Technologies for the IoT:Overview and Motivations.Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes,Quality of Service in IPv6, Migration Strategies to IPv6.	**8 Hours**
Case Studies- illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications	**5 Hours**
Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study	**8 Hours**

Course outcomes:

After studying this course, students will be able to:

1.Understand the basic concepts of Internet of Things.
2.Analyse the different technologies for Internet of Things
3.Get the knowledge on IPv6 concepts
4.Able to demonstrates the IoT applications
5.Get the knowledge on IoT data analytics.

Question paper pattern:

It will have 5 questions.
1.Each full question carries 12 marks.
2.Each full question will have sub questions of internal choice type covering all topicsunder the unit.
3.The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1.Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6:The EvolvingWorld of M2M Communications", Wiley, 2013.
2.Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands on Approach" Universities Press., 2015.

Reference Books:

1.Michael Miller," The Internet of Things", First Edition, Pearson, 2015.
2.Claire Rowland,Elizabeth Goodman et.al.," Designing Connected Products", First Edition,O'Reilly, 2015.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	0	0	0	0	0	0	3
CO2	3	2	1	2	3	1	0	0	0	0	0	3
CO3	3	2	1	2	3	1	0	0	0	0	0	3
CO4	3	2	1	2	3	2	0	0	0	0	0	3
CO5	3	2	1	2	3	2	0	0	0	0	0	3

ADAPTIVE SIGNAL PROCESSING

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	21ECSP203B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: To understand

- Meaning of "adaption" in terms of signal processing and geometrical terms.
- And analyze basic non-recursive adaptive filter, that is, the adaptive linear combiner.
- Performance or error surface under stationary and non-stationary conditions.
- LMS algorithms and other types of adaptive algorithms. Understand adaptive modelling and system identification; inverse adaptive modelling, de-convolution and equalization.

Unit -1	**Teaching Hours**
Introduction to Adaptive Systems: **Adaptive Systems:** Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response Performance function - Gradient & Mean Square Error.	**10 Hours**
Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error. **Searching the performance surface** – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution – Stability & Rate of convergence - Learning Curves.	**10 Hours**
Steepest Descent Algorithms: Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.	**10 Hours**
LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms – LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm. **Applications:** Noise cancellation – Cancellation of Echoes in long distance telephone circuits, Adaptive Beam forming.	**10 Hours**
Kalman Filtering: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Examples using Kalman filtering.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Design optimal minimum mean square estimators and in particular linear estimators.

- Implement adaptive filters (FIR, IIR, non-causal, causal) and evaluate their performance.
- Identify applications in which it would be possible to use the different adaptive filtering approaches.
- Understand Principles of LMS Algorithm & Applications
- Explain applications of Kalman Filtering

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Adaptive Signal Processing - Bernard Widrow, Samuel D.Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4th Ed., 2002, PE Asia.

Reference Books:

1. Optimum signal processing: An introduction - Sophocles. J. Orfamadis, 2nd Ed., 1988,McGraw- Hill, New York
2. Adaptive signal processing-Theory and Applications - S.Thomas Alexander, 1986,Springer – Verlag.
3. Signal analysis – Candy, Mc Graw Hill Int. Student Edition
4. James V. Candy - Signal Processing: A Modern Approach, McGraw- Hill, InternationalEdition, 1988.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	0	0	1	0	0	0	0	0	0	3
CO2	3	2	0	0	1	0	0	0	0	0	0	3
CO3	3	2	0	0	1	0	0	0	0	0	0	3
CO4	3	2	0	0	1	0	0	0	0	0	0	3
CO5	3	2	0	0	1	0	0	0	0	0	0	3

BIO MEDICAL SIGNAL PROCESSING

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	21CSP203C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: To understand

- Meaning of "bio medical" in terms of signal processing and geometrical terms.
- And analyze basic physiological signal acquiring.
- Bio medical signal processing .
- Principal signal component analysis.

Unit -1	**Teaching Hours**
Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters	**10 Hours**
Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering	**10 Hours**
Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time- frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)	**10 Hours**
Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non- stationary signals, Coherent treatment of various biomedical signal processing methods and applications.	**10 Hours**
Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multi resolution analysis(MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA). Pattern classification–supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.	**10 Hours**

Course outcomes:

At the end of this course, students will be able to

- Understand different types of biomedical signal.
- Identify and analyze different biomedical signals.
- Find applications related to biomedical signal processing

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topicsunder the unit.
4. The student will have to answer all 5 full questions with the opted choice in eachquestion.

Text Books:

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall,1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son'spublication,2001.

Reference Books:

1. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
2. D C Reddy, "Biomedical Signal Processing", McGraw Hill,2005.Katarzyn J. Blinowska, JaroslawZygierewicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press,2011

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	0	0	1	0	0	0	0	0	0	3
CO2	3	2	0	0	1	0	0	0	0	0	0	3
CO3	3	2	0	0	1	0	0	0	0	0	0	3
CO4	3	2	0	0	1	0	0	0	0	0	0	3
CO5	3	2	0	0	1	0	0	0	0	0	0	3

OPTICAL NETWORKS

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	21ECSP204A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Explain propagation of light and losses inside the fiber
- Understand the operation of various optical active and passive components
- Explain system model and various optical networks
- Understand control management techniques.

Unit -1	**Teaching**
Introduction: Propagation of signals in optical fiber, Different losses, Nonlinear effects, Solutions, Optical sources, Detectors.	**10 Hours**
Optical components: Couplers, Isolators, Circulators, Multiplexers, Filters, Gratings, Interferometers, Amplifiers. Modulation - Demodulation: Formats, Ideal receivers, Practical detection receivers, Optical preamplifiers, Noise considerations, Bit error rates, Coherent detection.	**10 Hours**
Transmission system engineering: System model, Power penalty, Transmitter, Receiver, Different optical amplifiers, Dispersion. **Optical Networks**: Client layers of optical layer, SONET/SDH, Multiplexing, layers, Frame structure, ATM functions, Adaptation layers, Quality of Service (QoS) and flow control, ESCON, HIPPL.	**10 Hours**
WDM network elements: Optical line terminal, Optical line amplifiers, Optical cross connectors, WDM network design, Cost trade offs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion, Statistical dimensioning model.	**10 Hours**
Control and management: Network management functions, management framework, Information model, management protocols, Layers within optical layer performance and fault management, Impact of transparency, BER measurement, Optical trace, Alarm management, Configuration management.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Explain light propagation and losses inside the fiber
- Understand the operation of various optical components
- Understand and explain system model and various optical networks
- Explain the concept of WDM technique for optical networks
- Explain control management techniques

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. John M. Senior, **"Optical fiber communication",** Pearson edition, 2000.
2. Gerd Kaiser, **"Optical fiber Communication Systems",** John Wiley, New York, 1997.

Reference Books:

1. Rajiv Ramswami and K. N. Sivarajan, **"Optical Networks",** Morgon Kauffman Publishers, 2000.
2. P. E. Green, **"Optical Networks",** Prentice Hall, 1994.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

MODERN SPECTRUM ANALYSIS AND ESTIMATION

Effective from the academic year 2021-2022

SEMESTER – III

Subject Code	21ECSP204B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: This course will enable students to:

- Understand Energy Spectral Density of deterministic signals and Power SpectralDensity of random signals
- Understand various methods for spectrum estimation
- Explain filter band method and optimum filter method

Unit -1	**Teaching**
Basic Concepts: Introduction, Energy Spectral Density of deterministic signals, Power Spectral Density of random signals, properties of Power Spectral Densities, The Spectral Estimation problem, Coherence Spectrum.	**10 Hours**
Spectrum Estimation: Introduction, Correlogram method, Periodogram Computation ia FFT, properties of Periodogram method such as bias analysis, window design considerations. Signals with Rational spectra. ARMA state – space Equation, sub space Parameter Estimation.	**10 Hours**
Parametric Methods for line Spectra: Models of sinusoidal Signals in Noise, Non-linear least squares method. High Order Yule Walker method, Min – Norm Method, ESPRIT Method, Forward – Backward Estimatuion**.**	**10 Hours**
Filter Bank Method: Filter bank Interpretation of the period gram, Refined Filter bank Method, Capon Method, Filter Bank Reinterpretation of the periodogram.	**10 Hours**
Optimum Linear Filter: Optimum Signal Estimation, Linear MSE Estimation, Solution of the normal equations optimum FIR and IIR filters. Inverse filtering and deconvolution.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

- Understand Energy Spectral Density of deterministic signals and Power Spectral Density of random signals
- Understand various methods for spectrum estimation
- Understand parametric methods for line spectra
- Explain filter bank method and optimum filter method
- Understand signal estimation techniques

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.

4. The student will have to answer all 5 full questions with the opted choice in each question.
Text Books: 1. Stoica and Moses, **"Introduction to Spectral Analysis"**, PHI, 1997.
Reference Books: 1. Monalakis, Ingle and Kogen, **"Stastical and Adaptive Signal Procedssing"**, Tata McGraw Hill. 2000.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

ELCTROMAGNETIC INTERFERENCE
AND
ELECTROMAGENTIC OMPATIBILITY

Effective from the academic year 2021-2022

SEMESTER – III

Subject Code	21ECSP204C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: This course will enable students to:

- To introduce enough knowledge regarding the Electromagnetic interference/ Electromagnetic compatibility, Its practical experiences and concerns, and various sources both the natural and Nuclear sources of EMI.
- To know the practical experiences due to EMI such as mains power supply, switches and relaysetc and Analyze EM Propagation and Crosstalk
- To know various methods of the measurements radiated and conducted interference in open area test sites and in chambers.
- To Learn about the various methods of minimizing the EMI.
- To know the National/International EMC Standards.

Unit -1	**Teaching**
Introduction, Natural and Nuclear Sources of EMI / EMC:Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations, An overview of EMI / EMC, Natural and Nuclear sources of EMI.	**10 Hours**
EMI from Apparatus, Circuits and Open Area Test Sites:Electromagnetic emissions, Noise from relays and switches, Non-linearities in circuits, passive inter modulation, Cross talk in transmission lines, Transients in power supply lines, Electromagnetic interference (EMI), Open area test sites and measurements.	**10 Hours**
Radiated and Conducted Interference Measurements and ESD: Anechoic chamber, TEM cell, GH TEM Cell, Characterization of conduction currents / voltages, Conducted EM noise on power lines, Conducted EMI from equipment, Immunity to conducted EMI detectors and measurements, ESD, Electrical fast transients / bursts, Electrical surges.	**10 Hours**
Grounding, Shielding, Bonding and EMI filters: Principles and types of grounding, Shielding and bonding, Characterization of filters, Power lines filter design.	**10 Hours**
Cables, Connectors, Components and EMC Standards: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, National / International EMC standards.	**10 Hours**

Course outcomes:

- At the end of this course the student can able to:
- Understand the electromagnetic environment the definitions of EMI and EMC, history of EMI some examples of practical experiences due to EMI such as mains power supply, switches and relays etc.
- Understand the celestial electromagnetic noise the occurrence of lightning discharge and their effects, the charge accumulation and discharge in an electrostatic discharge, model ESD wave form, the various cases of nuclear explosion and the transients.
- Understand the methods to measure RE and RS in the open are test sites .
- Understand the measurement facilities and procedures using anechoic chamber, TEM cell, reverberating chamber GTEM cell.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in eachquestion.

Text Books:

1. Engineering Electromagnetic Compatibility - Dr. V.P. Kodali, IEEEPublication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Electromagnetic Interference and Compatibility IMPACTseries,IIT – Delhi, Modules 1-9

Reference Books:

1. Introduction to Electromagnetic Compatibility - Ny, John Wiley, 1992, by C.R. Pal.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	1	0	1	0	0	0	0	0	0	3
CO3	3	2	1	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

DIGITAL IMAGE & VIDEO PROCESSING LABORATORY

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	21ECSP251	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	48	**Exam Hours**	03

Credits – 02

Course objectives: This course will enable students to:

- Understand the concepts of digital image and video signal processing operations

Experiments

A. Minimum of 10 Experiments have to be conducted

B. All Experiments may be Simulated using MATLAB and to be verified theoretically.

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

1.

Course outcomes: At the end of this course, students will be able to

1. Perform image and video enhancement
2. Perform image and video segmentation
3. Detect an object in an image/video

Conduct of Practical Examination:

1. Ten questions will be given and student should choose one question (blind option) carries 50 marks in total.
2. (a) 40 marks will be allotted for write-up, execution and result.
   (b) 10 marks will be allotted for viva voce.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO2	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO3	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

DETECTION AND ESTIMATION THEORY LAB

Effective from the academic year 2021-2022

SEMESTER – II

Subject Code	21ECSP252	**IA Marks**	50
Number of Lecture Hours/Week	04	**Exam Marks**	50
Total Number of Lecture Hours	48	**Exam Hours**	03

Credits – 02

Course objectives: This course will enable students to:

Understand the concepts of adaptive signal detection with and without noise and comparison of signal estimation techniques

Experiments

1.Simulate signal and noise models models.
2.Simulate spatially separated target Signal in the presence of Additive Correlated White Noise
3.Simulate spatially separated target Signal in the presence of Additive Uncorrelated White Noise
4.Simulate spatially separated target Signal in the presence of Additive Correlated Colored Noise
5.Detect Constant amplitude Signal in AWGN
6.Detect Time varying Known Signals in AWGN
7.Detect Unknown Signals in AWGN
8.Compare performance comparison of the Estimation techniques - MLE, MMSE, Bayes Estimator, MAP Estimator, Expectation Maximization (EM) algorithm
9.Performance comparison of conventional Energy Detectors and Coherent Matched Filter Techniques

Course outcomes: At the end of this course, students will be able to

1.Simulate signals and noise
2.Detect signals in the presence of noise
3. Compare various estimation techniques

Conduct of Practical Examination:

1. Ten questions will be given and student should choose one question (blind option) carries 50 marks in total.
2. (a) 40 marks will be allotted for write-up, execution and result.
   (b) 10 marks will be allotted for viva voce.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO2	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO3	**3**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

SPEECH PROCESSING

Effective from the academic year 2021-2022

SEMESTER – III

Subject Code	21ECSP301A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: This course will enable students to:

- Familiarize the basic mechanism of speech production and get anvoverview of articulatory and acoustic Phonetics.
- Learn the basic concepts of methods for speech analysis and parametricvrepresentation of speech.
- Acquire knowledge about various methods used for speech and audio coding.
- Get an overall picture about various applications of speech and audio processing.

Unit -1	**Teaching Hours**
Digital Models For The Speech Signal: Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals. (Text 1) **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.	**10 Hours**
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. **Short Time Fourier Analysis:** Linear Filtering interpretation, Filter bank summation method, Overlap addition method, Design of digital filter banks, Implementation using FFT, Spectrographic displays, Pitch detection, Analysis by synthesis, Analysis synthesis systems.	**10 Hours**
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.	**10 Hours**
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,	**10 Hours**

Evaluation, Practical speech synthesis.	
Automatic Speech Recognition: Introduction, Speech recognition vs.Speaker recognition, Signal processing and analysis methods, Patterncomparison techniques, Hidden Markov Models, Artificial Neural Networks. **Audio Processing:** Auditory perception and psychoacoustics - Masking,frequency and loudness perception, spatial perception, Digital Audio, AudioCoding - High quality, low-bit-rate audio coding standards, MPEG, AC- 3, Multichannel audio - Stereo, 3D binaural and Multichannel surround sound.	**10 Hours**

Course outcomes: After studying this course, students will be able to:

- Understand basic concepts of speech production, speech analysis and synthesis
- Analyze Speech coding techniques
- Understand Speech and speaker recognition systems.
- Understand Concepts of Audio Processing and learn modeling
- Implement Applications-New audiogram matching techniques

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. L. R. Rabiner and R. W. Schafer, **"Digital Processing of Speech Signals"**, PearsonEducation (Asia) Pte. Ltd., 2004.
2. L. R. Rabiner and B. Juang, **"Fundamentals of Speech Recognition"**, Pearson Education(Asia) Pte. Ltd., 2004.
3. Z. Li and M.S. Drew, "**Fundamentals of Multimedia**", Pearson Education (Asia) Pte.
4. Ltd., 2004.

Reference Books:

1. D. O'Shaughnessy, **"Speech Communications: Human and Machine"**, Universities Press, 2001.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO2	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO3	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO4	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
CO5	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

TRANSFORM TECHNIQUES

Effective from the academic year 2021-2022

SEMESTER – III

Subject Code	21ECSP301B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives: This course will enable students to:

- Familiarize the fourier analysis
- Learn the basic concepts of transforms and their applications
- Acquire knowledge about wavelet transforms.
- Get an overall picture about wavelet packets and lifting

Unit -1	**Teaching Hours**
Fourier Analysis: Fourier series, Examples, Fourier Transform, Properties of Fourier Transform, Examples of Fourier transform, sampling theorem, Partial sum and Gibbs phenomenon, Fourier analysis of Discrete time Signals, Discrete Fourier Transform. Time – Frequency Analysis: Window function, Short Time Fourier Transform, Discrete Short Time Fourier Transform, Continuous wavelet transform, Discrete wavelet transform, wavelet series, Interpretations of the Time-Frequency plot.	**10 Hours**
Transforms: Walsh, Hadamard, Haar and Slant Transforms, DCT, DST, KLT, Singular value Decomposition – definition, properties and applications	**10 Hours**
Continuous Wavelet Transform (CWT): Short comings of STFT, Need for wavelets, Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWTTiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat, Meyer, Shannon, Daubechies	**10 Hours**
Multi Rate Analysis and DWT: Need for Scaling function – Multi Resolution Analysis, Two-Channel Filter Banks, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet Basis, DWT, Structure of DWT Filter Banks, Daubechies Wavelet Function, Applications of DWT.	**10 Hours**

Unit -5	
Wavelet Packets and Lifting: Wavelet Packet Transform, Wavelet packet algorithms, Thresholding Hard thresholding, Soft thresholding, Multidimensional Wavelets, Bi-orthogonal basis- B-Splines, Lifting Scheme of Wavelet Generation, Multi Wavelets	**10 Hours**

Course outcomes: After studying this course, students will be able to:

- The student will learn basics of two-dimensional transforms.
- Understand the definition, properties and applications of various two-dimensional transform.
- Understand the basic concepts of wavelet transform.
- Understand the special topics such as wavelet packets, Bi-orthogonal wavelets e.t.c.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1.A Wavelet Tour of Signal Processing theory and applications -RaghuveerM.Rao and Ajit S. Bopardikar, Pearson Edu, Asia, New Delhi, 2003.
2. K.P.Soman and K.I Ramachandran, " Insight into Wavelets – from theory to practice" PHI, Second edition,2008

Reference Books:

1. Fundamentals of Wavelets- Theory, Algorithms and Applications -Jaideva C Goswami, Andrew K Chan, John Wiley & Sons, Inc, Singapore, 1999.
2. JaidevaC.Goswami and Andrew K.Chan, " Fundamentals of Wavelets" Wiley publishers, 2006
3. A Wavelet Tour of Signal Processing-Stephen G. Mallat, Academic Press, 2 Ed 4. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar – TMH,2009

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	0	0	1	0	0	0	0	0	0	3
CO2	3	2	0	0	1	0	0	0	0	0	0	3
CO3	3	2	0	0	1	0	0	0	0	0	0	3
CO4	3	2	0	0	1	0	0	0	0	0	0	3
CO5	3	2	0	0	1	0	0	0	0	0	0	3

PATTERN RECOGNITION AND MACHINE LEARNING

Effective from the academic year 2021-2022

SEMESTER – III

Subject Code	21ECSP301C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.
- To introduce students to a variety of pattern recognition algorithms.
- Enable students to apply machine learning concepts in real life problems

.

Unit -1	**Teaching Hours**
Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis	**10 Hours**
Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification	**10 Hours**
Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning	**10 Hours**
Linear discriminant functions - decision surfaces, two-category, multi-category, minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine	**10 Hours**
Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers **Unsupervised learning and clustering –** k-means clustering, fuzzy k-means clustering, hierarchicalclustering	**10 Hours**

Course outcomes:

At the end of this course, students will be able to

1. Study the parametric and linear models for classification
2. Understand the concepts of neural networks
3. Design neural network and SVM for classification
4. Develop the training methods of neural networks
5. Develop machine independent and unsupervised learning techniques

Question paper pattern:

1.It will have 5 questions.

2.Each full question carries 12 marks.

3.Each full question will have sub questions of internal choice type covering all topics under the unit.

4.The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. **Richard O. Duda, Peter E. Hart, David G. Stork,** "Pattern Classification", 2nd Edition John Wiley & Sons,2001.
2. **Trevor Hastie, Robert Tibshirani, Jerome H. Friedman,** "The Elements of Statistical Learning", 2nd Edition, Springer,2009.

Reference Books:

1. C. Bishop, "Pattern Recognition and Machine Learning", Springer,2006

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	3	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

OPTIMIZATION TECHNIQUES

Effective from the academic year 2021-2022

SEMESTER – III

Subject Code	21ECSP302AC	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Understand the basics of linear programming.
- To introduce optimization techniques
- Enable students to apply optimization methods in real life problems

.

Unit -1	**Teaching Hours**
Introduction to Classical Methods and Linear Programming Problems Terminology. Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.	**10 Hours**
Linear Programming Problem,Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.	**10 Hours**
Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method	**10 Hours**
Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based Smethod, Cauchy‘s Steepest descent method, Newton‘s method , Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method	**10 Hours**
Intelligent Optimization Techniques:Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Crammer Approach - Example Problems. Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.	**10 Hours**

Course outcomes:

At the end of this course, students will be able to

1. Understand importance of optimization
2. Apply basic concepts of mathematics to formulate an optimization problem
3. Analyze various optimization problems.
4. performance measures for various optimization problems.
5. Apply the suitable optimization problems for different applications

Question paper pattern:

1.It will have 5 questions.

2.Each full question carries 12 marks.

3.Each full question will have sub questions of internal choice type covering all topics under the unit.

4.The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. S. S. Rao, "Engineering Optimization: Theory and Practice", Wiley,2008.
2. K. Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall, 2005.

Reference Books:

1. C.J. Ray, "Optimum Design of Mechanical Elements", Wiley,2007.
2. 2. R. Saravanan, "Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications,2006.
3. 3. D. E. Goldberg, "Genetic algorithms in Search, Optimization, and Machine learning", AddisonWesley Longman Publishing,1989.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	3	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

MODELLING AND SIMULATION TECHNIQUES Effective from the academic year 2021-2022 SEMESTER – III			
Subject Code	21ECSP302B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Course objectives:

This course will enable students to:

- To equip students with basics of discrete signals and systems
- Know the various modelling techniques and also to apply them to different systemsalgorithms.
- Enable students to apply simulation techniques to various processes

.

Unit -1	**Teaching Hours**
Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.	**10 Hours**
Unit -2	
Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.	**10 Hours**
Unit -3	
Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, MonteCarloMethods.Stochastic Processes and Markov Chains, Time Series Models.	**10 Hours**
Unit -4	
Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.	**10 Hours**
Unit -5	
Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics	**10 Hours**

Course outcomes:

At the end of this course, students will be able to

1. Identify and model discrete systems (deterministic and random)
2. Identify and model discrete signals (deterministic and random)
3. Understand modelling techniques to characterize systems/processes.
4. Understand simulation techniques to characterize systems
5. Understand simulation techniques to characterize processes

Question paper pattern:

1.It will have 5 questions.

2.Each full question carries 12 marks.

3.Each full question will have sub questions of internal choice type covering all topics under the unit.

4.The student will have to answer all 5 full questions with the opted choice in each question.

Text Books: 1. R. L. Woods and K. L. Lawrence, "Modeling and Simulation of Dynamic Systems", PrenticeHall,1997.
Reference Books: 1. Z. Navalih, "VHDL Analysis and Modelling of Digital Systems", McGraw-Hill,1993. 2. J. Banks, JS. Carson and B. Nelson, "Discrete-Event System Simulation", 2ndEdition, PrenticeHall of India,1996

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	3	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

ARTIFICIAL INTELLIGENCE Effective from the academic year 2020 -2021 SEMESTER - III			
Subject Code	21ECSP302C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60

Total Number of Lecture Hours	50	**Exam Hours**	03
Credits - 03			
Course objectives: The course objective is to make students understanding the concepts of AI techniques knowledge representation issues			
Unit -1			**Teaching Hours**
What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are A Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.			**10 Hours**
Unit -2			
Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.			**10 Hours**
Unit -3			
Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays‟ Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory. Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC			**10 Hours**
Unit -4			
Game Playing: Overview, And Example Domain: Overview, Mini Max, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction			**10 Hours**
Unit -5			
Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI			**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1.Understand the concept of Artificial Intelligence
2.search techniques and knowledgerepresentation issues
3.Understanding reasoning
4.Understand concept of fuzzy logic for artificial intelligence
5.Understanding game playing and natural language processing

Question paper pattern:

1.It will have 5 questions.
2.Each full question carries 12 marks.
3.Each full question will have sub questions of internal choice type covering all topics under the unit.
4.The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1.Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2.Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rdEdition, Prentice Hall, 2009.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	0	1	1	0	0	0	0	0	0	0	3
CO2	2	0	1	1	0	0	0	0	0	0	0	3
CO3	2	0	1	1	0	0	0	0	0	0	0	3
CO4	2	0	1	1	0	0	0	0	0	0	0	3
CO5	2	0	1	1	0	0	0	0	0	0	0	3
CO6	2	0	1	1	0	0	0	0	0	0	0	3

(DISSERTATION) DISSERTATION PHASE – I AND PHASE – II

Syllabus Contents: The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

- The dissertation should have the following
- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:
- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:
Experimental verification / Proof of concept.
Design, fabrication, testing of Communication System.
The viva-voce examination will be based on the above report and work

Guidelines for Dissertation Phase – I and II at M. Tech.:
- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January toJune.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.
- The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogs should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverable: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q &A.
- In case of unsatisfactory performance, committee may recommend repeating the Phase-I work. During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished

results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents. Phase – II deliverable: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress. Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q &A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ Nat ional conference or reputed journals.

Course Structure for M.Tech. (VLSI & ES) Under the Regulations of SITE-21

First Year (Semester – I)

S.No.	Category	Course Code	Name of the Subject	L	T	P	C
1	CE	21ECVE101	Principles of Embedded Systems	3	0	0	3
2	CE	21ECVE102	CMOS Analog IC Design	3	0	0	3
Elective-I							
3	PE	21ECVE103A	Physical Design Automation	3	0	0	3
		21ECVE103B	Digital System Synthesis and Verification	3	0	0	
		21ECVE103C	Advanced Digital Design	3	0	0	
Elective-II							
4	PE	21ECVE104A	Micro controllers for Embedded System Design	3	0	0	3
		21ECVE104B	Embedded and Real Time Systems	3	0	0	
		21ECVE104C	Network Security and Cryptography	3	0	0	
5	MC	21ECVE105	Research methodology and IPR	2	0	0	2
6	CE	21ECVE151	Advanced VLSI Design Lab I	0	0	4	2
7	CE	21ECVE152	Embedded System Lab	0	0	4	2
8	AUD	21ECVE106	Audit course 1	2	0	0	-
			Total Credits				**18**

First Year (Semester – II)

S.No.	Category	Course Code	Name of the Subject	L	T	P	C
1	CE	21ECVE201	Internet of Things	3	0	0	3
2	CE	21ECVE202	VLSI Testing and Testability	3	0	0	3
Elective-I VLSI design course							
3	PE	21ECVE203A	Functional Verification using Hardware VerificationLanguages	3	0	0	3
		21ECVE203B	CMOS Mixed Signal Circuit Design	3	0	0	
		21ECVE203C	Low Power VLSI Design	3	0	0	
Elective-II Embedded system course							
4	PE	21ECVE204A	Embedded System Design	3	0	0	3
		21ECVE204B	Sensors And Actuators	3	0	0	
		21ECVE204C	Micro Electro Mechanical System (MEMS) Design	3	0	0	0
5	CE	21ECVE251	Advanced VLSI Design Lab II	0	0	3	2
6	CE	21ECVE252	IOT Lab	0	0	3	2
7	MP	21ECVE253	Mini Project	0	0	0	2
8	AUD 2	21ECVE206	Audit course	2	0	0	0
			Total Credits				**18**

Second Year (Semester – III)

S.No.	Category	Course Code	Name of the Subject	L	T	P	C
1	PE	21ECVE301A	VLSI Technology	3	0	-	3
		21ECVE301B	CPLD and FPGA Architectures and Applications	3	0	-	-
		21ECVE301C	Programming Languages for Embedded Systems	3	0	-	-
2	OE	21ECVE302A	Optimization Techniques	3	0	-	3
		21ECVE302B	Modeling and Simulation Techniques	3	0	-	
		21ECVE302C	Artificial Intelligence	3	0	-	
3	Dissertation	21ECVE351	Dissertation Phase -I /Industrial Project (to be continued and evaluated next semester)	-	0	20	10
Total Credits							**16**

Second Year (Semester – IV)

S.No	Category	Course Code	Name of the Subject	L	T	P	C
1	Dissertation Project/ Dissertation Phase	21ECVE451	Project/ Dissertation Phase-II	0	0	0	16
Total Credits							**16**

PRINCIPLES OF EMBEDDED SYSTEMS

Effective from Academic Year 2021 -2022

SEMESTER – I

Subject Code	21ECVE101	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	43	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of embedded systems architecture and their internal components

Unit -1	**Teaching Hours**
Introduction - Introduction to embedded systems: Overview, Common Design Metrics, Processor Technology, IC technology, Design technology, Trade-offs, Custom Single-Purpose Processors: Hardware, Combinational logic, Sequential logic, Custom single-purpose processor design, Optimization of Custom single-purpose processors	**10 Hours**
Unit -2	
General-Purpose Processors - Software, Basic Architecture, Operation, Programmer's View, Development Environment, Application-Specific Instruction-Set Processors (ASIPs), General-Purpose Processor Design	**10 Hours**
Unit -3	
Standard Single-Purpose Processors - Peripherals, UART, Pulse Width Modulators, LCD, Keypad and Stepper Motor Controllers, Analog-to-Digital Converters, Real-Time Clocks.	**8 Hours**
Unit -4	
Memory - common memory types, Advanced RAM, Interfacing: Terminology and Basic Protocol Concepts, Microprocessor Interfacing: Interrupts, Direct Memory Access, Arbitration. Multi-level bus architectures.	**8 Hours**
Unit -5	
Digital Camera Example - User's and Designer's perspective, Requirements specification, Design. **Introduction to Real Time Operating Systems** - OS and RTOS basics, Real time operating system architecture.	**7 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the fundamentals of embedded systems.
2. Understand the concepts of general purpose processors and its applications.
3. Get the concepts of embedded systems peripheral interfacing process
4. Analysis the different memories and bus architecture used in embedded systems
5. Able to design of small scale embedded systems

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.

4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Frank Vahid, Tony Givargis (2005), "Embedded System Design", J Wiley India.
2. David Simon (1999), "An Embedded Software Primer", Pearson Education.

Reference Books:

1. K V K K Prasad, "Embedded Real Time Systems: Concepts, Design Programming", Dreamtech Press.
2. Wayne Wolf (2012), "Computers as Components: Principles of Embedded Computing
3. System Design", 3rd Ed, Morgan Kaufmann publishers.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	0	3	0	0	0	0	0	0	3
CO2	2	1	1	0	3	0	0	0	0	0	0	3
CO3	2	1	1	0	3	0	0	0	0	0	0	3
CO4	2	1	1	0	3	0	0	0	0	0	0	3
CO5	2	1	1	0	3	0	0	0	0	0	0	3

CMOS ANALOG IC DESIGN

Effective from Academic Year 2021 -2022

SEMESTER - I

Subject Code	21ECVE102	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the fundamentals of analog IC design in CMOS logic.

Unit -1	**Teaching Hours**
SAMPLE AND HOLD: Properties of MOS Switches, multiplexed input architectures, recycling architecture, open and closed loop sampling architectures, switched capacitor and current mode architectures.	**10 Hours**
Unit -2	
BUILDING BLOCK OF DATA CONVERSION CIRCUITS: Amplifiers, open loop and closed loop amplifiers, gain boosting, common mode feedback, bipolar, CMOS and BiCMOS comparators.	**10 Hours**
Unit -3	
PRECISION TECHNIQUES: Comparator cancellation, input and output offset storage principles, comparators using offset cancelled latches, op-amp offset cancellation, ADC and DAC calibration techniques.	**10 Hours**
Unit -4	
ADC/DAC ARCHITECTURES: DAC Performance metrics, reference multiplication and division, switching and logical functions of DACs, Current steering architectures, DAC Performance metrics, Flash ADC architecture, Gray encoding, thermometer encoding and metastability.	**10 Hours**
Unit -5	
OVER SAMPLING CONVERTERS: Delta sigma modulators, alternative modulator architectures, quantization and noise shaping, decimation filtering, implementation of Delta sigma modulators, delta sigma DACs	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the basic properties of MOS switches and sample/hold architecture.
2. Get the basics of data conversion circuits' building blocks and amplifiers.
3. Understand the precision and calibration procedures for ADC and DAC circuits.
4. Get the basic architectures for ADC and DAC circuits and different performance metrics related to them.
5. Understanding the concepts of modulators and noise shaping techniques.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.

4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. B.Razavi, Data Conversion System Design, IEEE Press and John Wiley, 1995.
2. P R Gray and R G Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009.
3. Mohammed Ismail and Terri Fiez, Analog VLSI: Signal and Information Processing, McGraw-Hill, 1994.
4. Geiger, Allen and Stradder, VLSI Design Techniques for Analog and Digital Circuits,
5. Tata McGraw-Hill Education, 2010.

Reference Books:

1. Phillip Allen and Douglas Holmberg, CMOS Analog Circuit Design, Second Edition.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	0	1	0	0	0	0	0	0	0	3
CO2	1	2	0	1	0	0	0	0	0	0	0	3
CO3	1	2	0	1	0	0	0	0	0	0	0	3
CO4	1	2	0	1	0	0	0	0	0	0	0	3
CO5	1	2	0	1	0	0	0	0	0	0	0	3
CO6	1	2	0	1	0	0	0	0	0	0	0	3

PHYSICAL DESIGN AUTOMATION
Effective from Academic Year 2021 -2022
SEMESTER - III

Subject Code	21ECVE103A	**IA Marks**	40
Number of Lecture Hours/Week	04	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:
The course objective is to make students understanding the concepts of EDA methodologies for IC design.

Unit -1	**Teaching Hours**
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.	**10 Hours**
Unit -2	
DESIGN RULES: Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms – partitioning.	**10 Hours**
Unit -3	
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.	**10 Hours**
Unit -4	
SIMULATION: Simulation - Gate-level modeling and simulation - Switch-level modeling and simulationCombinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.	**10 Hours**
Unit -5	
MODELLING AND SYNTHESIS: High level Synthesis - Hardware models - Internal representation - Allocation - assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.	**10 Hours**

Course outcomes:
After studying this course, students will be able to:

1. Understand the fundamentals of graph theory for algorithmic representation of IC design flow.
2. Get the basics of design rules for layout drawing of IC design.
3. Understand the methods of performing floorplanning and routing algorithms in IC design.
4. Understand the concepts of simulation at various stages of IC design.
5. Get the information of advanced techniques for synthesis in IC design flow.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. S.H. Gerez, Algorithms for VLSI Design Automation, John Wiley & Sons, 2002.
2. N.A. Sherwani, Algorithms for VLSI Physical Design Automation, Kluwer Academic Publishers, 2002.

Reference Books:

1. Sadiq M. Sait, Habib Youssef, VLSI Physical Design automation: Theory and Practice, World scientific 1999.
2. Steven M.Rubin, Computer Aids for VLSI Design, Addison Wesley Publishing 1987.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	0	2	3	0	0	0	0	0	0	3
CO2	1	2	0	2	3	0	0	0	0	0	0	3
CO3	1	2	0	2	3	0	0	0	0	0	0	3
CO4	1	2	0	2	3	0	0	0	0	0	0	3
CO5	1	2	0	2	3	0	0	0	0	0	0	3
CO6	1	2	0	2	3	0	0	0	0	0	0	3

DIGITAL SYSTEM SYNTHESIS AND VERIFICATION

Effective from Academic Year 2021 -2022

SEMESTER – I

(Elective I)

Subject Code	21ECVE103B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of synthesis of digital system design blocks and verification techniques and methods using System Verilog.

Unit -1	**Teaching Hours**
VERILOG BASIC CONCEPTS: Operators, Basic concepts, Identifiers, System task and functions, Value set, Data types, Parameters ,Operands, Operators, Modules and ports, Gate-level Modeling, Dataflow Modeling, Behavioral Modeling, Test bench-lab exercise.	**10 Hours**
Unit -2	
VERILOG ADVANCED FEATURES: Tasks and Functions, Timing and delays, Switch level modeling, Tri state gates, MOS Switches, Bidirectional switches, User defined primitives, Combinational UDP, Sequential UDP, lab exercise. Introduction to synthesis, Verilog HDL synthesis-Synthesis Design flow –lab exercise.	**10 Hours**
Unit -3	
SYSTEM VERILOG INTRODUCTION: Introduction to System Verilog – Literal values-data Types, Arrays, Data Declarations-attributes-operators, expressions, procedural statements and control flow. Processes in System Verilog – Task and functions.	**10 Hours**
Unit -4	
OBJECT ORIENTED ANALYSIS IN SYSTEM VERILOG: Introduction to objects, its properties, methods, constructors- casting – chaining - Data hiding and encapsulation – polymorphism. Random constraints – randomization method. Inline constraints, Disabling random variables , controlling constraint, In-line random variable control randomization of scope variable.	**10 Hours**
Unit -5	
SYSTEM VERILOG ADVANCED FEATURES: Interprocessor synchronization - communication- scheduling semantics clocking blocks-assertions- Hierarchy-Interfaces- System Tasks & functions – system Verilog assertion API and coverage API.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of Verilog programming language and test bench definition.
2. Get the advanced features of Verilog programming and synthesis approach using Verilog.
3. Understand the basics of System Verilog programming for circuit verification.

4. Understand the object oriented analysis approach of System Verilog and itsproperties.
5. Get the advanced features of System Verilog programming.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Samir palnitkar, Verilog HDL, Pearson education, Second Edition,2003.
2. J. Bhasker, A Verilog HDL Primer, Second Edition, Star Galaxy, 1999.
3. System Verilog 3.1a –Language Reference Manual (Accellera Extensions to Verilog 2001), 2004.

Reference Books:

1. J. Bhasker, A Verilog Synthesis: A Practical Primer, Star Galaxy, 1998.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	0	2	2	3	0	0	0	0	0	0	3
CO2	2	0	2	2	3	0	0	0	0	0	0	3
CO3	2	0	2	2	3	0	0	0	0	0	0	3
CO4	2	0	2	2	3	0	0	0	0	0	0	3
CO5	2	0	2	2	3	0	0	0	0	0	0	3
CO6	2	0	2	2	3	0	0	0	0	0	0	3

ADVANCED DIGITAL DESIGN

Effective from Academic Year 2021 -2022

SEMESTER – I

(Elective I)

Subject Code	21ECVE103C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of advanced digital design concepts and the role Verilog and System Verilog in it.

Unit -1	**Teaching Hours**
SEQUENTIAL CIRCUIT DESIGN: Analysis of clocked synchronous sequential circuits and modeling- State diagram, state table, state table assignment and reduction-Design of synchronous sequential circuit design of iterative circuits-ASM chart and realization using ASM.	**10 Hours**
Unit -2	
ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN: Analysis of asynchronous sequential circuit – flow table reduction-races-state assignment transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards – data synchronizers – mixed operating mode asynchronous circuits – designing vending machine controller.	**10 Hours**
Unit -3	
FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS: Fault table method-path sensitization method – Boolean difference method-D algorithm - Tolerance techniques – The compact algorithm – Fault in PLA – Test generation-DFT schemes – Built in self-test.	**10 Hours**
Unit -4	
SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES: Programming logic device families – Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA-Xilinx 4000.	**10 Hours**
Unit -5	
SYSTEM DESIGN USING VERILOG: Hardware Modelling with Verilog HDL – Logic System, Data Types and Operators For Modelling in Verilog HDL - Behavioural 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 – Registers – counters – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of synchronous sequential circuit design using state machines and ASM chart.

2. Understand the asynchronous sequential circuit design methods.
3. Understand the concepts of fault diagnosis and testability algorithms.
4. Understand the synchronous design approach using programmable devices such as FPGA.
5. Get the basics of hardware modelling using Verilog and System Verilog.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Charles H.Roth Jr, Fundamentals of Logic Design, Thomson Learning 2004
2. Nripendra N Biswas, Logic Design Theory, Prentice Hall of India, 2001.
3. Parag K.Lala, Fault Tolerant and Fault Testable Hardware Design, B S Publications, 2002.
4. Parag K.Lala, Digital system Design using PLD, B S Publications, 2003.

Reference Books:

1. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999.
2. M.G.Arnold, Verilog Digital – Computer Design, Prentice Hall (PTR), 1999.
3. S. Palnitkar, Verilog HDL – A Guide to Digital Design and Synthesis, Pearson, 2003.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	0	0	0	0	0	0	3
CO2	2	1	2	2	2	0	0	0	0	0	0	3
CO3	2	1	2	2	2	0	0	0	0	0	0	3
CO4	2	1	2	2	2	0	0	0	0	0	0	3
CO5	2	1	2	2	2	0	0	0	0	0	0	3
CO6	2	3	2	2	3	0	0	0	0	0	0	3

MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN

Effective from Academic Year 2021-2022

SEMESTER – I

(Elective II)

Subject Code	21ECVE104A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	49	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students understanding the embedded systems peripheral interfacing and basic C coding concepts

Unit -1	**Teaching Hours**
Introduction to Embedded Systems: Overview of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Complex System Design, Design Process in Embedded System, Formalization of System Design, Classification of Embedded Systems.	**10 Hours**
Unit -2	
Microcontrollers and Processor Architecture & Interfacing: 8051 Architecture, Input/ Output Ports and Circuits, External Memory, Counters and Timers, PIC Controllers. Interfacing Processor (8051, PIC), Memory Interfacing, I/O Devices, Memory Controller and Memory arbitration Schemes.	**10 Hours**
Unit -3	
Structural Programming Concepts: Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: structuring the 'Hello Embedded World' example and goat-counting example using MAIN.H and PORT.H, Creating 'hardware delays' using Timer 0 and Timer 1, Example: Generating a precise hardware delay of 50 ms.	**10 Hours**
Unit -4	
Embedded RISC Processors & Embedded System-on Chip Processor: PSOC (Programmable System-on-Chip) architectures, Continuous Timer blocks, Switched Capacitor blocks, I/O blocks, Digital blocks, Programming of PSOC, Embedded RISC Processor architecture – ARM Processor architecture, Register Set, Modes of operation and overview of Instructions	**10 Hours**
Unit -5	
Interrupts & Device Drivers: Exceptions and Interrupt handling Schemes – Context & Periods for Context Switching, Deadline & interrupt latency. Device driver using Interrupt Service Routine, Serial port Device Driver, Device drivers for Internal Programmable timing devices	**9 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the fundamentals of Embedded systems design
2. Understand the concepts of 8051 microcontroller architecture and interfacing.
3. Describe the concepts of object oriented programming tools.
4. Analysis the different SoC architectures.
5. Understand the interrupt handling and device drivers concepts.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Embedded Systems - Architecture Programming and Design – Raj Kamal, 2nd ed., 2008,TMH.
2. PIC Microcontroller and Embedded Systems – Muhammad Ali Mazidi, Rolin D.Mckinaly, Danny Causy – PE.
3. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008.
4. Designers Guide to the Cypress PSOC – Robert Ashpy, 2005, Elsevier.

Reference Books:

1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.
2. ARM Systems Developers Guides- Design & Optimizing System Software - Andrew
3. N. Sloss, Dominic Symes, Chris Wright, 2004, Elsevier.
4. Designing with PIC Microcontrollers- John B. Peatman, 1998, PH Inc.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	0	2	0	0	0	0	0	0	3
CO2	3	2	3	0	3	0	0	0	0	0	0	3
CO3	3	1	2	0	2	0	0	0	0	0	0	3
CO4	3	1	1	0	2	0	0	0	0	0	0	3
CO5	3	1	1	0	2	0	0	0	0	0	0	3

EMBEDDED AND REAL TIME SYSTEMS

Effective from Academic Year 2021 -2022

SEMESTER – I

(Elective II)

Subject Code	21ECVE104B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	48	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students understanding the embedded systems design tools and techniques.

Unit -1	**Teaching Hours**
Introduction to Embedded Computing and ARM Processors Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries – ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance-CPU power consumption.	**10 Hours**
Unit -2	
Embedded Computing Platform Design The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis – Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.	**10 Hours**
Unit -3	
Processes and Operating Systems Introduction – Multiple tasks and multiple processes – Multi-rate systems- Preemptive real-time operating systems-Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.	**10 Hours**
Unit -4	
System Design Techniques and Networks Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors.	**10 Hours**
Unit -5	
Case Study Data compressor – Alarm Clock – Audio player – Software modem-Digital still camera – Telephone answering machine-Engine control unit – Video accelerator.	**8 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of advanced Embedded processors
2. Understand the fundamental design tools for embedded computing
3. Get the concepts of operating systems.
4. Able to analyze the system design techniques.
5. Able to demonstrate the small scale embedded systems operation and applications.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Marilyn Wolf, "Computers as Components – Principles of Embedded Computing
2. System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

Reference Books:

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2005.
6. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata
7. Mc Graw Hill, 2004.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	0	2	0	0	0	0	0	0	3
CO2	3	1	1	0	2	0	0	0	0	0	0	3
CO3	3	1	1	0	2	0	0	0	0	0	0	3
CO4	3	1	1	0	3	0	0	0	0	0	0	3
CO5	3	1	1	3	2	2	0	0	0	0	0	3

NETWORK SECURITY AND CRYPTOGRAPHY

Effective from the academic year 2018 -2019

SEMESTER – I

(Elective II)

Subject Code	21ECVE104C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	47	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students to learn the basic concepts of Network security, encryption algorithms and applications of network security

Unit -1	**Teaching Hours**
Introduction: Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security. Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques. **Modern Techniques:** Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations.	**10 Hours**
Unit -2	
Encryption Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers. Conventional Encryption :Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.	**8 Hours**
Unit -3	
Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptograpy. **Number Theory:** Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.	**10 Hours**
Unit -4	
Message Authentication and Hash Functions: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs. **Hash and Mac Algorithms** MD File, Message digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards. **Authentication Applications :**Kerberos, X.509 directory Authentication service, Electronic Mail Security: Pretty Good Privacy, S/MIME.	**10 Hours**
Unit -5	
IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management. Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction.	**9 Hours**

Intruders, Viruses and Worms: Intruders, Viruses and Related threats. **Fire Walls:** Fire wall Design Principles, Trusted systems.	

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of Network attacks and security services
2. Able to analyse different encryption algorithms
3. Understand the concepts of Cryptography principles
4. Get the knowledge on Authentication protocols and digital signature.
5. Describes the different web security applications and requirements

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Cryptography and Network Security: Principles and Practice - William Stallings, Pearson Education.
2. Network Security Essentials (Applications and Standards) by William Stallings
3. Pearson Education.

Reference Books:

1. Fundamentals of Network Security by Eric Maiwald (Dreamtech press)
2. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Principles of Information Security, Whitman, Thomson.
4. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
5. Introduction to Cryptography, Buchmann, Springer.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	0	0	0	0	0	3
CO2	3	2	1	1	2	1	0	0	0	0	0	3
CO3	3	2	1	1	2	1	0	0	0	0	0	3
CO4	3	2	1	1	3	1	0	0	0	0	0	3
CO5	3	2	1	1	2	1	0	0	0	0	0	3

RESEARCH METHODOLOGY & IPR Effective from Academic Year 2021-2022 SEMESTER – I			
Subject Code	21ECVE105	**IA Marks**	40
Number of Lecture Hours/Week	02	**Exam Marks**	60
Total Number of Lecture Hours	47	**Exam Hours**	03
Credits – 02			

Course objectives:
The course objective is to make students to learn the basic concepts of research methodology and intellectual property rights

Unit -1	**Teaching Hours**
Meaning of research problem, sources of research problem ,criteria characteristics of a good research Scope and objectives of Research problem. Approaches of Investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	**10 Hours**
Unit -2	
Effective literature studies approaches, analysis Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	**8 Hours**
Unit -3	
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT..	**10 Hours**
Unit -4	
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patentinformation and databases. Geographical Indications.	**10 Hours**
Unit -5	
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	**9 Hours**

Course outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today‟s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science& engineering students‟
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners” Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007

Reference Books:

1. Mayall, Industrial Design”, McGraw Hill, 1992.
2. Niebel, “Product Design”, McGraw Hill, 1974.
3. Asimov, “Introduction to Design”, Prentice Hall, 1962.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
5. Technological Age”, 2016.
6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	0	0	0	0	0	3
CO2	3	2	1	1	2	1	0	0	0	0	0	3
CO3	3	2	1	1	2	1	0	0	0	0	0	3
CO4	3	2	1	1	3	1	0	0	0	0	0	3
CO5	3	2	1	1	2	1	0	0	0	0	0	3

ADVANCED VLSI DESIGN LAB I

Effective from Academic Year 2021-2022

SEMESTER - I

Subject Code	21ECVE151	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	36	**Exam Hours**	03

Credits – 02

Course objectives:

The course objective is to make students understanding the basic concepts of digital design using Verilog HDL programming and able to execute simulation, synthesis, place and route, post P&R simulation, identifying critical paths and static timing analysis.

Part-I	**Teaching Hours**
Design, simulate and synthesis of digital logic blocks using Verilog HDL 1. Verilog implementation of a. 8:1 Mux/Demux, b. Full Adder, 8-bit Magnitude comparator, c. 3-bit Synchronous Counters d. Parity generator. 2. HDL based design entry and simulation of parameterizable cores of counters, shift registers, 3. HDL based design entry and simulation of Mealy and Moore FSM based sequence detector state machines,. 4. 8-bit parallel adders and 8-bit multipliers. 5. HDL based design entry and simulation of parameterizable cores on memory design and 4-bit ALU. 6. PCI Bus & arbiter and downloading on FPGA. 7. Verilog implementation of Arithmetic circuits serial adder/subtractor, parallel adder/subtractor. 8. Verilog implementation of Arithmetic circuits serial/parallel multiplier.	**36 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of digital design using EDA tools like Cadence, Xillinx, Mentor Graphics.
2. To design the given digital system , simulation and synthesis using Verilog and modern VLSI EDA tools.

Question paper pattern:

1. Ten questions will be given and student should choose one question (blind option) carries 50 marks in total.
   a. 40 marks will be allotted for write-up, execution and result.
   b. 10 marks will be allotted for viva voce.

Software Requirements:

1. Xillinx Vivado suite
2. ModelSim tool

Hardware Requirements:

1. Development kits of FPGA

EMBEDDED SYSTEM LAB

Effective from Academic Year 2021-2022

SEMESTER - I

Subject Code	21ECVE152	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	36	**Exam Hours**	03

Credits – 02

Course objectives:

The course objective is to make students understanding the basic concepts of Embedded systems and to implement the applications on ARM-CORTEX Processors.

Experiments on ARM-CORTEX processor using any open source RTOS (Coo-Cox-Software-Platform)	**Teaching Hours**
1. Implement the interfacing of display with the ARM- CORTEX processor. 2. Implement two digit 7-segment display with the ARM-CORTEX processor. 3. Interface ADC and DAC ports with the Input and Output sensitive devices. 4. Simulate the temperature DATA Logger with the SERIAL communication with PC. 5. Implement the developer board as a modem for data communication using 6. serial port communication between two PC's. 7. Temperature indication on an RGB LED. 8. Mimic light intensity sensed by the light sensor by varying the blinking te of an LED. 9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes. 10. System reset using watchdog timer in case something goes wrong. 11. Sample sound using a microphone and display sound levels on LEDs	**36 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of embedded systems
2. Understand the concepts of implementing example applications on ARM-CORTEX processor.

Question paper pattern:

1. Ten questions will be given and student should choose one question (blind option) carries 50 marks in total.
2. 40 marks will be allotted for write-up, execution and result.
3. 10 marks will be allotted for viva voce.

Software Requirements:

1. COO-COX Software Platform, YAGARTO TOOLS, and Java with latest version.

Hardware Requirements:

1. Development kits of ARM-Cortex Boards.
2. Serial Cables, Network Cables and recommended power supply for the board

INTERNET OF THINGS Elective from Academic Year 2021 -2022 SEMESTER - II			
Subject Code	21ECVE201	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	40	**Exam Hours**	03
Credits - 03			

Course objectives:
The course objective is to make students describe and design the IoT based applications.

Unit -1	**Teaching Hours**
Introduction-What is The Internet of Things? Overview and Motivations, Examples of Apllications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication ExamplesOverview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.	**10 Hours**
Unit -2	
IoT Technologies- Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT StandardsOverview and Approaches,IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol,Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Lowpower WPAN, Zigbee IP(ZIP), IPSO.	**9 Hours**
Unit -3	
Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity :IPv6 Technologies for the IoT:Overview and Motivations.Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes,Quality of Service in IPv6, Migration Strategies to IPv6.	**8 Hours**
Unit -4	
Case Studies- illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications	**5 Hours**
Unit -5	
Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.	**8 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the basic concepts of Internet of Things.
2. Analyze the different technologies for Internet of Things.
3. Get the knowledge on IPv6 concepts.
4. Able to demonstrates the IoT applications.
5. Get the knowledge on IoT data analytics.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications", Wiley, 2013.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands on Approach"
3. Universities Press., 2015.

Reference Books:

1. Michael Miller, "The Internet of Things", First Edition, Pearson, 2015.
2. Claire Rowland, Elizabeth Goodman et.al., "Designing Connected Products", First Edition,O'Reilly, 2015.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	0	0	0	0	0	0	3
CO2	3	2	1	2	3	1	0	0	0	0	0	3
CO3	3	2	1	2	3	1	0	0	0	0	0	3
CO4	3	2	1	2	3	2	0	0	0	0	0	3
CO5	3	2	1	2	3	2	0	0	0	0	0	3

VLSI TESTING AND TESTABILITY

Effective from Academic Year 2021 -2022

SEMESTER - II

Subject Code	21ECVE202	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students understanding the concepts of testing and verification methods and techniques in IC design.

Unit -1	**Teaching Hours**
Motivation for testing, Design for testability, the problems of digital and analog testing, Design for test, Software testing. Faults in Digital Circuits: Controllability, and Observability, Fault models - stuck-at faults, Bridging faults, intermittent faults.	**10 Hours**
Unit -2	
Digital Test Pattern Generation: Test pattern generation for combinational logic circuits, Manual test pattern generation, Automatic test pattern generation - Roth's Dalgorithm, Developments following Roth's D algorithm, Pseudorandom test pattern generation, Test pattern generation for sequential circuits, Exhaustive, non-exhaustive and pseudorandom 70 test pattern Generation, Delay fault testing.	**10 Hours**
Unit -3	
Signatures and Self Test: Input compression output compression arithmetic, ReedMuller and spectral coefficients, Arithmetic and Reed-Muller coefficients, Spectral coefficients, Coefficient test signatures, Signature analysis and online self test. Testability Techniques: Partitioning and ad-hoc methods and scan-path testing, Boundary scan and IEEE standard 1149.1, Offline built in Self Test (BIST), Hardware description languages and test.	**10 Hours**
Unit -4	
Testing of Analog and Digital circuits: Testing techniques for Filters, A/D Converters, Programmable logic devices and DSP, Test generation algorithms for combinational logic circuits – fault table, Boolean difference, Path sensitilization, Dalgorithm, Podem, Fault simulation techniques – serial single fault propagation, Deductive, Parallel and concurrent simulation, Test generation for a sequential logic, Design for testability – adhoc and structured methods, Scan design, Partial scan, Boundary scan, Pseudo-random techniques for test vector generation and response compression, Built–in-Self test, PLA test and DFT.	**10 Hours**
Unit -5	
Memory Design and Testing: 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.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the fundamentals of IC testing and basic terminology.
2. Get the methods of generating test patterns for testing of IC.
3. Get the various techniques and methods of IC testing.
4. Understand the concepts of analog and digital IC testing.
5. Understand the fundamentals of memory testing and various techniques.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits, Kluwer Academic Publishers. 2000
2. M. Abramovici, M.A. Breuer and A.D. Friedman, Digital Systems Testing and Testable Design, Wiley-IEEE Press, 1993.
3. N.K. Jha and S. Gupta, Testing of Digital Systems, Cambridge University Press, 2004.
4. L-T. Wang, C-W. Wu and X. Wen, VLSI Test Principles and Architectures, Morgan Kaufman Publishers, 2006.
5. P.H. Bardell, W.H. McAnney and J. Savir, Built-in Test for VLSI: Pseudorandom Techniques, Wiley Interscience, 1987.

Reference Books:

1. A.K Sharma, Semiconductor Memories Technology, Testing and Reliability, IEEE Press.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	0	0	0	0	0	0	0	3
CO2	1	2	1	1	0	0	0	0	0	0	0	3
CO3	1	2	1	1	0	0	0	0	0	0	0	3
CO4	1	2	1	1	0	0	0	0	0	0	0	3
CO5	1	2	1	1	0	0	0	0	0	0	0	3
CO6	1	2	1	1	0	0	0	0	0	0	0	3

FUNCTIONAL VERIFICATION USING HARDWARE VERIFICATION LANGUAGES

Effective from Academic Year 2021 -2022

SEMESTER - II

Subject Code	21ECVE203A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students understanding the concepts of functional verification methods and hardware verification languages.

Unit -1	**Teaching Hours**
VERIFICATION TECHNOLOGIES AND TOOLS: Importance of Verification - Reconvergence Model - The Human Factor - Formal and Functional Verification Approaches - Timing Verification - Testing Versus Verification - Design and Verification Reuse - Linting - Simulation - Third Party Models - Verification Intellectual Property - Waveform Viewers - Code Coverage - Functional Coverage - Issue Tracking – Metrics - Role of the Verification Plan - Levels of Verification - Verification Strategies.	**10 Hours**
Unit -2	
HIGH-LEVEL MODELING: High-Level Versus RTL Thinking - Structure of High-Level Code - Data Abstraction - Object-Oriented Programming - Parallel Simulation Engine - Race Conditions - Portability Issues.	**10 Hours**
Unit -3	
STIMULUS AND RESPONSE: Simple Stimulus - Simple Output - Complex Stimulus - Bus-Functional Models - Response Monitors - Transaction Level Interface.	**10 Hours**
Unit -4	
ARCHITECTING TESTBENCHES AND SIMULATION MANAGEMENT: Verification Harness - Design Configuration - Self-Checking Test benches - Directed Stimulus - Random Stimulus - System Level Verification Harnesses - Transaction Level Models - Managing Simulations - Regression.	**10 Hours**
Unit -5	
VERIFICATION METHODOLOGY: Universal Verification Methodology (UVM) – Packages – Components – Environmental Structure – Factory Registration – Reporting.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the fundamentals of verification techniques and tools required for hardware verification.
2. Get the basics of high-level modeling and object-oriented programming for hardware verification.
3. Understand the techniques for stimulus generation and monitoring the output of verification methods.
4. Understand the methods of test bench creating and simulation management of test bench

and design block together.
5. Get the information of UVM methods in hardware verification.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Janick Bergeron, Writing Test Benches Using System Verilog, Springer, 2009.
2. Chris Spear, Greg Tumbush, System Verilog for Verification - A Guide to Learning the Testbench Language Features, Springer, 2012.
3. Sharon Rosenberg and Kathleen Meade, A Practical Guide to Adopting the Universal Verification Methodology (UVM), Cadence Design Systems, Inc., 2013.

Reference Books:

1. Andreas Meyer, Principles of Functional Verification, Newnes, 2003.
2. Kropf T, Introduction to Formal Hardware Verification, Springer Verlag, 2010.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	0	0	0	0	0	0	0	3
CO2	1	2	1	1	0	0	0	0	0	0	0	3
CO3	1	2	1	1	0	0	0	0	0	0	0	3
CO4	1	2	1	1	0	0	0	0	0	0	0	3
CO5	1	2	1	1	0	0	0	0	0	0	0	3
CO6	1	2	1	1	0	0	0	0	0	0	0	3

CMOS MIXED SIGNAL CIRCUIT DESIGN

Effective from Academic Year 2021 -2022

SEMESTER - II

Subject Code	21ECVE203B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students understanding the concepts of capacitor circuits, PLL and data converters in CMOS mixed signal circuit design.

Unit -1	**Teaching Hours**
SWITCHED CAPACITOR CIRCUITS: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, Biquad filters.	**10 Hours**
Unit -2	
PHASED LOCK LOOP (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.	**10 Hours**
Unit -3	
DATA CONVERTER FUNDAMENTALS: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based Converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters.	**10 Hours**
Unit -4	
NYQUIST RATE A/D CONVERTERS: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D Converters, Folding A/D converters, Pipelined A/D converters, Time-Interleaved Converters.	**10 Hours**
Unit -5	
OVERSAMPLING CONVERTERS: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of switched capacitor circuits operation and analysis.
2. Get the basics of PLL and its applications.
3. Understand the fundamentals of data converters and specifications of basic D/A conversion.
4. Understand the types of A/D converters using mixed signal circuit design.
5. Get the fundamentals of oversampling converters and noise shaping modulators.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH Edition, 2002.
2. Philip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, International 2nd Edition/Indian Edition, 2010.
3. David A. Johns, Ken Martin, "Analog Integrated Circuit Design", Wiley Student Edition, 2013.

Reference Books:

1. Rudy Van De Plassche, CMOS Integrated Analog-to-Digital and Digital-to Analog converters, Kluwer Academic Publishers, 2003.
2. Richard Schreier, Understanding Delta-Sigma Data converters, Wiley Interscience, 2005.
3. R. Jacob Baker, CMOS Mixed-Signal Circuit Design, Wiley Interscience, 2009.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	0	0	0	0	0	0	0	3
CO2	2	1	2	1	0	0	0	0	0	0	0	3
CO3	2	1	2	1	0	0	0	0	0	0	0	3
CO4	2	1	2	1	0	0	0	0	0	0	0	3
CO5	2	1	2	1	0	0	0	0	0	0	0	3
CO6	2	1	2	1	0	0	0	0	0	0	0	3

LOW POWER VLSI DESIGN

Effective from Academic Year 2021 -2022

SEMESTER - II

Subject Code	21ECVE203C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of low power techniques, power estimation methods of IC design.

Unit -1	**Teaching Hours**
POWER DISSIPATION IN CMOS: Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design.	**10 Hours**
Unit -2	
POWER OPTIMIZATION: Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.	**10 Hours**
Unit -3	
DESIGN OF LOW POWER CMOS CIRCUITS: Computer arithmetic techniques for low power system – reducing power consumption in memories – low power clock, Inter connect and layout design – Advanced techniques – Special techniques.	**10 Hours**
Unit -4	
POWER ESTIMATION: Power Estimation techniques – logic power estimation – Simulation power analysis –Probabilistic power analysis.	**10 Hours**
Unit -5	
SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER: Synthesis for low power – Behavioral level transform – software design for low power.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the fundamentals of power parameters in CMOS logic.
2. Understand the methods of power optimization at various levels of design flow.
3. Get the concepts of power optimization in memories specifically at interconnect and layout level.
4. Understand the power estimation techniques using probabilistic and other methods.
5. Get the concepts of power optimization at synthesis stage.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Kaushik Roy and S.C.Prasad, Low power CMOS VLSI circuit design, Wiley, 2000.
2. Dimitrios Soudris, Chirstian Pignet, Costas Goutis, Designing CMOS Circuits for Low Power, Kluwer, 2002.
3. J.B.Kulo and J.H Lou, Low voltage CMOS VLSI Circuits, Wiley 1999.

Reference Books:

1. Gary Yeap, Practical low power digital VLSI design, Kluwer, 1998.
2. A.P.Chandrasekaran and R.W.Broadersen, Low power digital CMOS design, Kluwer,1995.
3. Abdelatif Belaouar, Mohamed.I.Elmasry, Low power digital VLSI design, Kluwer, 1995.
4. James B.Kulo, Shih-Chia Lin, Low voltage SOI CMOS VLSI devices and Circuits, John Wiley and sons, inc. 2001.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	0	0	0	0	0	0	0	3
CO2	2	2	1	2	0	0	0	0	0	0	0	3
CO3	2	2	1	2	0	0	0	0	0	0	0	3
CO4	2	2	1	2	0	0	0	0	0	0	0	3
CO5	2	2	1	2	0	0	0	0	0	0	0	3
CO6	2	2	1	2	0	0	0	0	0	0	0	3

EMBEDDED SYSTEM DESIGN Elective from Academic Year 2021 -2022 SEMESTER - II			
Subject Code	21ECVE204A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	46	**Exam Hours**	03
Credits - 03			

Course objectives:
The course objective is to make students to get the knowledge on embedded system design and development tools

Unit -1	**Teaching Hours**
Introduction An Embedded System-Definition, Examples, Current Technologies, Integration in system Design, Embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.	**8 Hours**
Unit -2	
Embedded Hardware Embedded hardware building blocks, Embedded Processors – ISA architecture models, Internal processor design, processor performance, Board Memory – ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and performance, Embedded board Input / output – Serial versus Parallel I/O, interfacing the I/O components, I/O components and performance, Board buses – Bus arbitration and timing, Integrating the Bus with other board components, Bus performance.	**10 Hours**
Unit -3	
Embedded Software Device drivers, Device Drivers for interrupt-Handling, Memory device drivers, On-board bus device drivers, Board I/O drivers, Explanation about above drivers with suitable examples. Embedded operating systems – Multitasking and process Management, Memory Management, I/O and file system management, OS standards example – POSIX, OS performance guidelines, Board support packages, Middleware and Application Software – Middle ware, Middleware examples, Application layer software examples.	**10 Hours**
Unit -4	
Embedded System Design, Development, Implementation and Testing: Embedded system design and development lifecycle model, creating an embedded system architecture, introduction to embedded software development process and tools- Host and Target machines, linking and locating software, Getting embedded software into the target system, issues in Hardware-Software design and co-design, Implementing the design-The main software utility tool, CAD and the hardware, Translation tools, Debugging tools, testing on host machine, simulators, Laboratory tools, System Boot-Up	**10 Hours**

Unit -5	
Embedded System Design-Case Studies Case studies- Processor design approach of an embedded system –Power PC Processor based and Micro Blaze Processor based Embedded system design on Xilinx platform-NiosII Processor based Embedded system design on Altera platform-Respective Processor architectures should be taken into consideration while designing an Embedded System.	**8 Hours**
Course outcomes: After studying this course, students will be able to: 1. Understand the concepts of current technologies if embedded systems design 2. Demonstrate the different types of embedded hardware modules 3. Get the knowledge on embedded software concepts 4. Analyze the embedded design and implementation tools. 5. Able to describes the processor design approaches.	
Question paper pattern: 1. It will have 5 questions. 2. Each full question carries 12 marks. 3. Each full question will have sub questions of internal choice type covering all topics under the unit. 4. The student will have to answer all 5 full questions with the opted choice in each 5. question.	
Text Books: 1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd.Publications, 2005. 2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.	
Reference Books: 1. Peter Marwedel, "Embedded System Design", Science Publishers, 2007. 2. Arnold S Burger, "Embedded System Design", CMP. 3. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.	

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	3	1	0	0	0	0	0	3
CO2	3	2	1	1	3	1	0	0	0	0	0	3
CO3	3	2	1	1	3	1	0	0	0	0	0	3
CO4	3	2	3	1	3	2	0	0	0	0	0	3
CO5	3	2	3	1	3	2	0	0	0	0	0	3

SENSORS AND ACTUATORS

Elective from Academic Year 2021-2022

SEMESTER – II

Subject Code	21ECVE204B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	48	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students to understand the different types of sensors operation, availability for the Embedded system design.

Unit -1	**Teaching Hours**
Sensors / Transducers: Principles – Classification – Parameters – Characteristics - Environmental Parameters (EP) – Characterization. **Mechanical and Electromechanical Sensors:** Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor – Types-Capacitive Sensors:– Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors.	**8 Hours**
Unit -2	
Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermosensors – Helium Low Temperature Thermometer – Nuclear Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors –Thermoemf Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors **Magnetic sensors:** Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magnetoresistive Sensing – Semiconductor Magnetoresistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros – Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors	**12 Hours**
Unit -3	
Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors. **Electro analytical Sensors:** Introduction – The Electrochemical Cell – The Cell Potential - Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media .	**8 Hours**
Unit -4	
Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation	**10 Hours**

Sensors-Applications: Introduction– On-board Automobile Sensors (Automotive Sensors) – Home Appliance Sensors – Aerospace Sensors — Sensors for Manufacturing –Sensors for environmental Monitoring	
Unit -5	
Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Pressure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators, Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection, Electrical Actuation Systems-Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors	**10 Hours**
Course outcomes: After studying this course, students will be able to: 1. Understand the basic concepts of electromechanical sensors. 2. Able to determine different types of thermal and magnetic sensors. 3. Describes the concepts of X-ray and Nuclear Radiation sensors 4. Get the knowledge on smart sensors for automation and automobile applications 5. Able to describes different types of actuators and its application.	
Question paper pattern: 1. It will have 5 questions. 2. Each full question carries 12 marks. 3. Each full question will have sub questions of internal choice type covering all topics under the unit. 4. The student will have to answer all 5 full questions with the opted choice in each question.	
Text Books: 1. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited. 2. W. Bolton – "Mechatronics" –Pearson Education Limited.	
Reference Books: 1. Sensors AndActruators – D. Patranabis – 2nd Ed., PHI, 2013.	

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	0	0	0	0	0	0	3
CO2	3	2	1	2	3	0	0	0	0	0	0	3
CO3	3	2	1	2	3	0	0	0	0	0	0	3
CO4	3	2	1	2	3	0	0	0	0	0	0	3
CO5	3	2	2	2	3	0	0	0	0	0	0	3

MICRO ELECTRO MECHANICAL SYSTEM (MEMS) DESIGN

Elective from Academic Year 2021 -2022

SEMESTER - II

Subject Code	21ECVE204C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	40	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students to understand the Micro Electro Mechanical System (MEMS) design concepts.

Unit -1	**Teaching Hours**
Introduction Basic structures of MEM devices–(Canti-Levers, Fixed Beams diaphragms).Broad Response of Micro electromechanical systems (MEMS) to Mechanical (Force, pressure etc.)Thermal, Electrical, optical and magnetic stimuli, compatibility of MEMS from the point of power dissipation, leakage etc**.**	**7 Hours**
Unit -2	
Review Review of mechanical concepts like stress, strain, bending moment, deflection curve. Differential equations describing the deflection under concentrated force, Distributed force, distributed force, Deflection curves for canti-levers- fixed beam. Electrostatic excitation – columbic force between the fixed and moving electrodes. Deflection with voltage in C.L, Deflection Vs Voltage curve, critical fringe field – field calculations using Laplace equation. Discussion on the approximate solutions – Transient response of the MEMS.	**10 Hours**
Unit -3	
Types Two terminal MEMS - capacitance Vs voltage Curve – Variable capacitor. Applications of variable capacitors. Two terminal MEM structures. Three terminal MEM structures – Controlled variable capacitors – MEM as a switch and possible applications.	**7 Hours**
Unit -4	
MEM Circuits & Structures MEM circuits & structures for simple GATES- AND, OR, NAND, NOR, Exclusive OR, simple MEM configurations for flip-flops triggering applications to counters, converters. Applications for analog circuits like frequency converters, wave shaping. RF Switches for modulation. MEM Transducers for pressure, forcetemperature. Optical MEMS.	**8 Hours**
Unit -5	
MEM Technologies: Silicon based MEMS- Process flow – Brief account of various processes and layers like fixed layer, moving layers spacers etc., and etching technologies. Metal Based MEMS: Thin and thick film technologies for MEMS. Process flow and description of the processes, Status of MEMS in the current electronics scenario.	**8 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the basic concepts of MEM devices.
2. Able to review the different mechanical and electrical concepts for MEM's.
3. Able to analyse different types of MEM's.
4. Get the knowledge on MEM structures and components.
5. Able to demonstrate the concepts of MEM technologies.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. MEMS Theory, Design and Technology - GABRIEL. M.Review, R.F.,2003, John wiley& Sons. .
2. Strength of Materials –ThimoShenko, 2000, CBS publishers & Distributors.
3. MEMS and NEMS, Systems Devices; and Structures - ServeyE.Lyshevski, 2002, CRC Press.

Reference Books:

1. Sensor Technology and Devices - Ristic L. (Ed) , 1994, Artech House, Londo.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	3	2	0	0	0	0	0	3
CO2	3	1	2	1	3	2	0	0	0	0	0	3
CO3	3	1	2	1	3	2	0	0	0	0	0	3
CO4	3	1	2	1	3	2	0	0	0	0	0	3
CO5	3	1	2	1	3	2	0	0	0	0	0	3

ADVANCED VLSI DESIGN LAB II

Effective from Academic Year 2021 2022

SEMESTER - II

Subject Code	21ECVE251	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	36	**Exam Hours**	03

Credits – 02

Course objectives:

The course objective is to make students understanding the concepts of capacitor circuits, PLL and data converters in CMOS mixed signal circuit design.

To design and implement the Circuit and Layout of any ten Experiments using CMOS 130nm Technology with Mentor Graphics Tool/Cadence/ Synopsys/Industry Equivalent Standard Software.	**Teaching Hours**
1. Design of CMOS Inverter - Circuit Simulation, transfer characteristic curve, transient analysis, Layout design. 2. Lambda calculation for PMOS & NMOS, Tranconductance plots, Single transistor amplifier. 3. Design of Current Mirrors - Simple current source generator, Current mirror, Wilson Current mirror circuit, Layout of the current mirror circuit. 4. Design of Current Sinks - Basic current sink, Current sink with negative feedback, Bootstrap current sink, Cascode current sink, Regulated cascode current sink. 5. Design of Differential Amplifier - Measure gain, ICMR, and CMRR - Differential input, single ended differential amplifier design, Differential amplifier design. 6. telescopic amplifier design, layout of differential amplifier. 7. Clock Divider. 8. JK-Flip Flop. 9. Synchronous Counter. 10. Asynchronous Counter. 11. Static RAM Cell.	**36 Hours**
For the above circuits, Circuit simulation, Layout generation, parasitic extraction, Identification of critical paths, power consumption, P&R, power and clock routing, postP&R simulation and Static timing analysis need to be executed.	

Course outcomes:

After studying this course, students will be able to:

1. Design CMOS logic circuits using MENTOR GRAPHICS tool.
2. Understand the concepts of lambda calculation for MOS transistors.
3. Design a variety of current mirrors circuits.
4. Design a variety of current sink circuits.
5. Design differential amplifier and measure all the related circuit parameters.

Question paper pattern:

1. Ten questions will be given and student should choose one question (blind option) carries 50marks in total.
    a. 40 marks will be allotted for write-up, execution and result.
    b. 10 marks will be allotted for viva voce.

Software Requirements:

1. Mentor Graphics Tool/Cadence/ Synopsys/Industry Equivalent Standard Software.

CO-PO Mapping

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	3	0	0	0	0	0	0	3
CO1	2	3	2	2	3	0	0	0	0	0	0	3
CO1	2	3	2	2	3	0	0	0	0	0	0	3
CO1	2	3	2	2	3	0	0	0	0	0	0	3
CO1	2	3	2	2	3	0	0	0	0	0	0	3

IoT LAB Effective from Academic Year 2021-2022 SEMESTER - II			
Subject Code	21ECVE252	**IA Marks**	50
Number of Lecture Hours/Week	03	**Exam Marks**	50
Total Number of Lecture Hours	36	**Exam Hours**	03
Credits – 02			

Course objectives:

1. To form a bridge between the industry and academic institutions to update their knowledge and To appreciate differences between Big Data, Cloud Computing and IoT.
2. To understand innovative application's needs such as Smart City, Smart Health, Smart Manufacturing, Smart Agriculture, etc.

Integrated Development Environment (IDE) which involves adding library files that are necessary to run all following exercises.	**Teaching Hours**
1. LED Blink and Pattern 2. LED Pattern with Push Button Control 3. LM35 Temperature Sensor 4. Analog Input & Digital Output 5. IR Sensor Analog Input 6. LCD 16X2 Display 7. IR Sensor Based Security System 8. Fire Alarm Using Arduino 9. Thermometer using LM35 with LCD display 10. Servo Motor Control with Potentiometer	**36 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Separate IoT hype from the reality.
2. Effective usage of IoT deployment for different sectors.
3. Trace the relationship between IoT, cloud services and software agents.
4. Create IoT based applications under in-house expert guidance.
5. Students will become more industry ready.
6. Fill Technology gap between Industry and Institute will be reduced.

Question paper pattern:

1. Ten questions will be given and student should choose one question (blind option) carries 50marks in total.
    a. 40 marks will be allotted for write-up, execution and result.
    b. 10 marks will be allotted for viva voce.

CO-PO Mapping

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	3	0	0	0	0	0	0	3
CO2	2	3	2	2	3	0	0	0	0	0	0	3
CO3	2	3	2	2	3	0	0	0	0	0	0	3

VLSI TECHNOLOGY

Effective from Academic Year 2020 -2021

SEMESTER - III

Subject Code	21ECVE301A	**IA Marks**	40
Number of Lecture Hours/Week	04	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of technology steps and tools required for IC fabrication.

Unit -1	**Teaching Hours**
CRYSTAL GROWTH, WAFER PREPARATION, EPITAXY AND OXIDATION: Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing consideration, Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism And kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopant At interface, Oxidation of Poly Silicon, Oxidation inducted Defects.	**10 Hours**
Unit -2	
LITHOGRAPHY AND RELATIVE PLASMA ETCHING: Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, relative Plasma Etching techniques and Equipments.	**10 Hours**
Unit -3	
DEPOSITION, DIFFUSION, ION IMPLEMENTATION AND METALLIZATION: Deposition process, Polysilicon, plasma assisted Deposition, Models of Diffusion in Solids, Flick's one Dimensional Diffusion Equation – Atomic Diffusion Mechanism – Measurement techniques – Range Theory- Implant equipment. Annealing Shallow junction – High energy implantation – Physical vapors Deposition – Patterning.	**10 Hours**
Unit -4	
PROCESS SIMULATION AND VLSI PROCESS INTEGRATION: Ion implantation – Diffusion and oxidation – Epitaxy – Lithography – Etching and Deposition- NMOS IC Technology – CMOS IC Technology – MOS Memory IC technology - Bipolar IC Technology – IC Fabrication.	**10 Hours**
Unit -5	
ANALYTICAL, ASSEMBLY TECHNIQUES AND PACKAGING OF VLSI DEVICES: Analytical Beams – Beams Specimen interactions - Chemical methods – Package types – banking design consideration – VLSI assembly technology – Package fabrication technology.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the steps of preparing semiconductor material using chemical processing.
2. Get the basics of lithography and etching concepts and related equipment.
3. Analyze the statistical behaviour of semiconductor material during deposition and diffusion.

4. Understand various MOS technologies for IC fabrication.
5. Get the basics of assembly and packaging types for IC fabrication.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. S.M.Sze, VLSI Technology, McGraw Hill, 2nd Edition. 2008.
2. James D Plummer, Michael D. Deal, Peter B.Griffin, Silicon VLSI Technology: fundamentals practice and Modeling, Prentice Hall India, 2009.

Reference Books:

1. Wai Kai Chen, VLSI Technology, CRC press, 2003.

O-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	0	1	1	0	0	0	0	0	0	0	3
CO2	2	0	1	1	0	0	0	0	0	0	0	3
CO3	2	0	1	1	0	0	0	0	0	0	0	3
CO4	2	0	1	1	0	0	0	0	0	0	0	3
CO5	2	0	1	1	0	0	0	0	0	0	0	3
CO6	2	0	1	1	0	0	0	0	0	0	0	3

CPLD AND FPGA ARCHITECTURES AND APPLICATIONS

Effective from Academic Year 2021 -2022

SEMESTER – I

(Elective-I)

Subject Code	21ECVE301B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of programmable hardware logic in the form of CPLD and FPGAs.

Unit -1	**Teaching Hours**
Programmable logic: ROM, PLA, PAL, PLD, PGA Features, programming and applications using complex programmable logic devices Altera series Max 5000/7000 series and Altera FLEX logic ± 10000 series CPLD, AMD CPLD (Mach 1 to 5); Cypres FLASH 370 Device Technology, Lattice LSI Architectures ± 3000 Series ± Speed Performance and in system programmability.	**10 Hours**
Unit -2	
FPGAs: Field Programmable Gate Arrays , Logic blocks, routing architecture, Design flow, Technology Mapping for FPGAs, Case studies, Xilinx XC4000 & ALTERA FLEX 8000/10000 FPGAs, AT & T ORCA (Optimized Reconfigurable Cell Array), ACTEL ACT-1, 2, 3 and their speed performance.	**10 Hours**
Unit -3	
Finite State Machines (FSM): Top Down Design, State Transition Table, State assignments for FPGAs, Problem of initial state assignment for one hot encoding, Derivations of state machine charges, Realization of state machine charts with a PAL, Alternative realization for state machine chart suing microprogramming, Linked state machines. One Hot state machine, Petrinets for state machines and basic concepts, properties, Extended petrinetes for parallel controllers, Finite State Machine Case Study, Meta Stability, Synchronization.	**10 Hours**
Unit -4	
FSM Architectures and System Level Design: Architectures centered around non-registered PLDs, State machine designs centered around shift registers, One Hot design method, Use of ASMs in One Hot design, K Application of One Hot method, System level design controller, data path and functional partition.	**10 Hours**
Unit -5	
Digital Front End Digital Design Tools for FPGAs & ASICs: Using Mentor Graphics EDA Tool FPGA Advantage, Design Flow Using FPGAs, Guidelines and Case Studies of parallel adder cell, parallel adder sequential circuits, counters, multiplexers, parallel controllers.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the fundamentals of programmable logic and CPLD.

2. Get the basics of FPGA architectures from industry perspective.
3. Analyze the sequential circuit design using FSMs and various properties of FSM design.
4. Understand the system level design for state machine implementation.
5. Get the basics of various industry standard tools for FPGA and ASIC design.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. P.K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall (Pte),1994.
2. S.Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Publicatgions,1994.
3. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork, 1995.

Reference Books:

1. S.Brown, R.Francis, J.Rose, Z.Vransic, Field Programmable Gate Array, Kluwer 1992.

CO-PO Mapping

COs / Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	0	0	0	0	0	0	0	0	3
CO2	2	1	1	0	0	0	0	0	0	0	0	3
CO3	2	1	1	0	0	0	0	0	0	0	0	3
CO4	2	1	1	0	0	0	0	0	0	0	0	3
CO5	2	1	1	0	0	0	0	0	0	0	0	3
CO6	2	1	1	0	0	0	0	0	0	0	0	3

PROGRAMMING LANGUAGES FOR EMBEDDED SYSTEM

Effective from Academic Year 2021 -2022

SEMESTER – III

Subject Code	21ECVE301C	**IA Marks**	40
Number of Lecture Hours/Week	04	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

The course objective is to make students understanding the concepts of Programming for embedded systems.

Unit -1	**Teaching Hours**
Embedded „C" Programming Bitwise operations, Dynamic memory allocation, OS services. Linked stack and queue, Sparse matrices, Binary tree. Interrupt handling in C, Code optimization issues. Embedded Software Development Cycle and Methods (Waterfall, Agile)	**10 Hours**
Unit -2	
Object Oriented Programming Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data abstraction and information hiding, inheritance, polymorphism	**10 Hours**
Unit -3	
CPP Programming: „cin", „cout", formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, „this" pointer, constructors, destructors, friend function, dynamic memory allocation	**10 Hours**
Unit -4	
Overloading and Inheritance: Need of operator overloading, overloading the assignment, Overloading using friends, type conversions, single inheritance, base and derived classes, friend Classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, Polymorphism, virtual functions.	**10 Hours**
Unit -5	
Templates: Function template and class template, member function templates and template arguments, Exception Handling: syntax for exception handling code: try-catch- throw, Multiple Exceptions. Scripting Languages: Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concepts of programming languages for embedded system design.
2. Write an embedded C application of moderate complexity.
3. Develop embedded C application.
4. Analyze algorithms in C++.
5. Differentiate interpreted languages from compiled languages.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice covering all topics
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Michael J. Pont , "Embedded C", Pearson Education, 2nd Edition, 2008
2. Randal L. Schwartz, "Learning Perl", O"Reilly Publications, 6th Edition 2011.

Reference Books:

1. A. Michael Berman, "Data structures via C++", Oxford University Press, 2002
2. Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company, 1999
3. Abraham Silberschatz, Peter B, Greg Gagne, "Operating System Concepts", John Willey & Sons, 2005Kaufmann.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	0	2	3	0	0	0	0	0	0	3
CO2	1	2	0	2	3	0	0	0	0	0	0	3
CO3	1	2	0	2	3	0	0	0	0	0	0	3
CO4	1	2	0	2	3	0	0	0	0	0	0	3
CO5	1	2	0	2	3	0	0	0	0	0	0	3

OPTIMIZATION TECHNIQUES

Effective from Academic Year 2021-2022

SEMESTER – III

Subject Code	21ECVE302A	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- Understand the basics of linear programming.
- To introduce optimization techniques
- Enable students to apply optimization methods in real life problems.

Unit -1	**Teaching Hours**
Introduction to Classical Methods and Linear Programming Problems Terminology. Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.	**10 Hours**
Unit -2	
Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.	**10 Hours**
Unit -3	
Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method	**10 Hours**
Unit -4	
Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based Smethod, Cauchy‘s Steepest descent method, Newton‘s method , Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method	**10 Hours**
Unit -5	
Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Crammer Approach - Example Problems. Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.	**10 Hours**

Course outcomes:

At the end of this course, students will be able to

1. Understand importance of optimization
2. Apply basic concepts of mathematics to formulate an optimization problem
3. Analyze various optimization problems.
4. Performance measures for various optimization problems.
5. Apply the suitable optimization problems for different applications

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. S. S. Rao, "Engineering Optimization: Theory and Practice", Wiley,2008.
2. K. Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall, 2005.

Reference Books:

1. C.J. Ray, "Optimum Design of Mechanical Elements", Wiley,2007.
2. R. Saravanan, "Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications,2006.
3. D. E. Goldberg, "Genetic algorithms in Search, Optimization, and Machine learning", AddisonWesley Longman Publishing,1989.

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	3	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

MODELLING AND SIMULATION TECHNIQUES

Effective from Academic Year 2021-2022

SEMESTER – III

Subject Code	21ECSP302B	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course objectives:

This course will enable students to:

- To equip students with basics of discrete signals and systems.
- Know the various modeling techniques and also to apply them to different systems algorithms.
- Enable students to apply simulation techniques to various processes.

.

Unit -1	**Teaching Hours**
Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.	**10 Hours**
Unit -2	
Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.	**10 Hours**
Unit -3	
Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, MonteCarlo Methods. Stochastic Processes and Markov Chains, Time Series Models.	**10 Hours**
Unit -4	
Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.	**10 Hours**
Unit -5	
Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics	**10 Hours**

Course outcomes:

At the end of this course, students will be able to

1. Identify and model discrete systems (deterministic and random).
2. Identify and model discrete signals (deterministic and random).
3. Understand modelling techniques to characterize systems/processes.
4. Understand simulation techniques to characterize systems.
5. Understand simulation techniques to characterize processes.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. 1. R. L. Woods and K. L. Lawrence, “Modeling and Simulation of Dynamic Systems”, PrenticeHall,1997.

Reference Books:

1. Z. Navalih, “VHDL Analysis and Modelling of Digital Systems”, McGraw-Hill,1993.
2. 2. J. Banks, JS. Carson and B. Nelson, “Discrete-Event System Simulation”, 2ndEdition, PrenticeHall of India,1996

CO-PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	0	1	0	0	0	0	0	0	3
CO2	3	2	3	0	1	0	0	0	0	0	0	3
CO3	3	2	3	0	1	0	0	0	0	0	0	3
CO4	3	2	1	0	1	0	0	0	0	0	0	3
CO5	3	2	1	0	1	0	0	0	0	0	0	3

ARTIFICIAL INTELLIGENCE

Effective from Academic Year 2021 -2022

SEMESTER - III

Subject Code	21ECVE302C	**IA Marks**	40
Number of Lecture Hours/Week	03	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

Course objectives:

The course objective is to make students understanding the concepts of AI techniques knowledge representation issues

Unit -1	**Teaching Hours**
What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are A Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.	**10 Hours**
Unit -2	
Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.	**10 Hours**
Unit -3	
Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays‟ Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory. Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC.	**10 Hours**
Unit -4	
Game Playing: Overview, And Example Domain: Overview, Mini Max, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction.	**10 Hours**
Unit -5	
Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.	**10 Hours**

Course outcomes:

After studying this course, students will be able to:

1. Understand the concept of Artificial Intelligence.
2. Search techniques and knowledgerepresentation issues.
3. Understanding reasoning.
4. Understand concept of fuzzy logic for artificial intelligence.
5. Understanding game playing and natural language processing.

Question paper pattern:

1. It will have 5 questions.
2. Each full question carries 12 marks.
3. Each full question will have sub questions of internal choice type covering all topics under the unit.
4. The student will have to answer all 5 full questions with the opted choice in each question.

Text Books:

1. Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rdEdition, Prentice Hall, 2009.

CO-PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	0	1	1	0	0	0	0	0	0	0	3
CO2	2	0	1	1	0	0	0	0	0	0	0	3
CO3	2	0	1	1	0	0	0	0	0	0	0	3
CO4	2	0	1	1	0	0	0	0	0	0	0	3
CO5	2	0	1	1	0	0	0	0	0	0	0	3
CO6	2	0	1	1	0	0	0	0	0	0	0	3

DISSERTATION PHASE–I AND PHASE–II Effective from Academic Year 2021 -2022 SEMESTER - IV			
Subject Code	21ECVE351 21ECVE451	**IA Marks**	-
Number of Lecture Hours/Week	-	**Exam Marks**	100
Total Number of Lecture Hours	-	**Exam Hours**	-
			Credits – 10+16
Course objectives: The course objective is to make students implementing real-time project based on latest research topics and publish their work in peer-review conference and journals.			

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following:

- Relevance to social needs of society.
- Relevance to value addition to existing facilities in the institute.
- Relevance to industry need.
- Problems of national importance.
- Research and development in various domains.

The student should complete the following:

- Literature survey problem definition.
- Motivation for study and objectives.
- Preliminary design / feasibility / modular approaches.
- Implementation and verification.
- Report and presentation.

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. The viva-voce examination will be based on this report and work. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.

Guidelines for Dissertation Phase–I and Phase-II:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.
- The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogs should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical

issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

- Phase–I deliverable: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase–I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q &A.
- In case of unsatisfactory performance, committee may recommend repeating the Phase-I work. During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase–II deliverable: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress.
- Phase–II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q &A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

Course Outcomes:

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

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Present the work in International/ National conference and Journals.

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	1	1	0	0	0	0	2	2	2	3
CO2	1	0	1	1	0	0	0	0	2	2	2	3
CO3	1	0	1	1	0	0	0	0	2	2	2	3
CO4	1	0	1	1	0	0	0	0	2	2	2	3