Guru Nanak Institute of Technology

(NAAC 'A+' Accredited an Autonomous Institute)

(Affiliated to Maulana Abul Kalam Azad University of Technology)

R25 [M.Tech., ECE]

Curriculum and Syllabus for M.Tech. under Autonomy

(NEP-2020 implemented)

Dept. of Electronics and Communication Engineering

(Effective from 2025-26 admission batch)

M. Tech. in Electronics & Communication Engineering (ECE)

PG-Syllabus,Guru Nanak Institute of Technology,
Panihati, Kolkata, West Bengal CURRICULUM and SYLLABUS (2025 Regulation)

SEMESTER I

Semester	GNIT_Core / Elective	GNIT_Paper code	GNIT Proposed subjects	Contact Hours/Week				Credit
				L	T	P	Total	
I	**Core 1**	MCE101	Advanced digital communication	3	0	0	3	3
	Core 2	MCE102	RF Circuit Design & Antenna	3	0	0	3	3
	PE1	MCE103A	Applications of Nanotechnology	3	0	0	3	3
		MCE103B	Detection and estimation theory					
		MCE103C	Advanced information theory					
	PE2	MCE104A	Quantum Communication	3	0	0	3	3
		MCE104B	Optical Communication and Networks					
		MCE104C	Advanced radio propagation					
	MLC	MLC101	Research methodology & IPR	2	0	0	2	2
	PRACTICAL							
	Lab 1	MCE191	Advanced Digital Communication Lab	0	0	3	3	2
	Lab 2	MCE192	RF Circuit Design & Antenna Lab	0	0	3	3	2
	Sessional - Aud 1	MCE 181	AUDIT COURSE-I (A)CONSTITUTION OF INDIA (B)PERSONALITY DEVELOPMENT (C)STRESS MANAGEMENT BY YOGA	2	0	0	2	0
							Total	**18**

SEMESTER II

Semester	GNIT_Core / Elective	GNIT_Paper code	GNIT_Proposed subjects	Contact Hours/Week				Credit
				L	T	P	Total	
II	**Core 1**	MCE201	Advanced digital Signal Processing	3	0	0	3	3
	Core 2	MCE202	Wireless and Mobile communication	3	0	0	3	3
	PE3	MCE203A	Cognitive radio networks	3	0	0	3	3
		MCE203B	Advanced image processing and pattern recognition					
		MCE203C	Data communication & network security					
	PE4	MCE204A	IoT in Communication Engineering	3	0	0	3	3
		MCE204B	Artificial intelligence in Wireless Communication					
		MCE204C	Engineering optimization techniques					
	Minor Project	MCE 281	MINI PROJECT AND SEMINAR	0	0	4	4	2
	PRACTICAL							
	Lab 1	MCE291	Advanced Digital Signal Processing Lab	0	0	3	3	2
	Lab 2	MCE292	Wireless and Mobile communication	0	0	3	3	2
	Sessional - Aud 1I	MCE 281	AUDIT COURSE-II (A) PEDAGOGY STUDIES (B)ENGLISH FOR RESEARCH PAPER WRITING (C) DISASTER MANAGEMENT	2	0	0	2	0
							Total	**18**

***MLC – Mandatory Learning Course*

SEMESTER III

Semester	GNIT_Core / Elective	GNIT_Paper code	GNIT_Proposed subjects	Contact Hours/Week				Credit
				L	T	P	Total	
III	PE5	MCE301A	Microelectronics & VLSI technology	3	0	0	3	3
		MCE301B	Device Modelling & simulation techniques					
		MCE301C	Information security & risk management					
	OE	MCE302A	Deep learning & computer vision	3	0	0	3	3
		MCE302B	Data Engineering					
		MCE302C	Advanced embedded systems					
	Major project	MCE381	Dissertation (Part-I)	0	0	20	20	10
							Total	16

SEMESTER IV

Semester	GNIT_Core / Elective	GNIT_Paper code	GNIT_Proposed subjects	Contact Hours/Week				Credit
				L	T	P	Total	
IV	Major project	MCE481	Dissertation (Complete)	0	0	32	32	16
							Total	16

SEMESTER I

Advanced Digital Communication
Course Code: MCE101
Contacts: 3-0-0
Total Contact Hours: 40
Credits: 3

Perquisites:

- Revision of probability and random variables.
- Revision of source coding and line coding.
- Revision of multiplexing and multiple access techniques.

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

1. Apply the concepts of probability and random processes to model and analyze digital communication systems under various noise conditions.
2. Analyze signal representations using signal space concepts, including Gram-Schmidt orthogonalization and likelihood-based detection, to evaluate communication system performance.
3. Compare and evaluate various digital modulation techniques (BPSK, QPSK, MSK, QAM, etc.) in terms of spectral efficiency, power efficiency, and error performance.
4. Design and interpret spread spectrum communication systems, including DSSS and FHSS, with understanding of pseudo-noise sequences and their correlation properties.
5. Explain and implement OFDM-based systems, addressing key challenges such as peak-to-average power ratio and synchronization issues, with a strong understanding of their architecture and signal processing.

Course Content:

Probability and Random Process [8L]: Review of random variables and random processes: PDF, CDF, mean, variance, correlation of random variables; classification of random processes, autocorrelation, cross-correlation, power spectral density, Gaussian process; narrowband noise; response of LTI systems to random signals; introduction random vectors.

Signal Space Analysis [8L]: Geometric representation of signals; Gram-Schmidt orthogonalization procedure; conversion of continuous AWGN channel into a vector channel; Likelihood functions; coherent detection of signals in noise :ML decoding, correlation receiver; probability of symbol and bit error.

Digital Modulation techniques [8L]: Review of BPSK, BFSK, QPSK modulation demodulation schemes-constellation diagram, PSD and error analysis; MSK, GMSK and QAM modulations-transmitter , receiver architecture, constellation diagram, PSD and error analysis.

Spread spectrum modulation [8L]: Brief history, importance, definition, classification (DHSS, FHSS), pseudo-noise sequence-autocorrelation and cross correlation, gold sequence; transmitter receiver architectures for DHSS and FHSS; signal space dimensionality and processing gain, CDMA and spread spectrum modulation.

OFDM [8L]: Data transmission using multiple carriers, multi-carrier modulation with overlapping sub channels; transmitter and receiver architectures of OFDM modulation, time-frequency representation of OFDM signals, cyclic prefix; challenges in OFDM: peak-to-average power ratio problem in OFDM, frequency and timing offset problem.

Text Books/References:

1. S. Haykin, Digital Communications Systems, Wiley Publications
2. B. P. Lathi, Z. Ding, Modern Digital and Analog Communication Systems, Oxford University Press
3. K. Feher, Wireless Digital Communications, PHI Pvt. Ltd.
4. H. Stark, J. W. Woods, Probability and random processes with applications to signal processing, PHI pvt. Ltd.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		1	1			2		3
CO2	3			3	3		2			1	3
CO3	3	3	3	3	2	2			1		3
CO4	3	3	3	2	3		2			2	2
CO5	3	3	3			2	2	3	1	2	

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3		
CO3	3	2	2
CO4	3	2	2
CO5	3	3	2

RF Circuit Design & Antenna
Course Code: MCE102
Contacts: 3:0:0
Total contact hours: 36
Credit: 3

Course Outcome:

After successful completion of this course, students should be able to:

CO1: Explain the different planar strip line techniques
CO2: Understand the MIC fabrication and measurement techniques.
CO3: Learn the design concepts MIC using various numerical analysis technique and applications of MIC
CO4: Acquire a knowledge about Microwave Semiconductor Devices
CO5: Learn antenna fundamentals and use tools for simulation and testing of RF circuits and antennas

Course Content:

1. **MIC Fabrication And Measurement Techniques** **6L**

Introduction to MICs-Fabrication technology, Advantages and applications. Measurement techniques: Test fixture measurements, probe station measurements, Experimental field probing techniques and anechoic chamber measurement, MIC applications.

2. Planar Transmission Lines and Lumped Elements for MICs: **7L**

Fundamentals of the theory of transmission lines, Foundations of Microstrip lines, Striplines, Higher modes in microstrips and striplines, Slotlines, Coplanar waveguides, Coplanar strips; Launching Techniques: Coaxial line to microstrip transition, Rectangular waveguide to microstrip transition, microstrip to slot-line transition, microstrip to coplanar waveguide (CPW) transition;

3. Microwave Planar Filters: **4L**

Periodic structures, Filter design by the Image Parameter method, Filter design by the Insertion Loss method, Filter transformations, Filter implementation,.

4. 4-Port Network Design: **5L**

Introduction; Even-and odd-mode analysis; Introduction to Branch-line coupler, Hybrid-ring couplers, Analysis of hybrid-ring couplers, Introduction to parallel-coupled lines and directional couplers; Multiple section directional couplers.

5. Nonlinear RF Circuits: **5L**

Introduction; Power Gain Relations; Noise characterization and design options; Switches: Pin Diode switches, FET switches, MEMS switches; Variable attenuators, Phase shifters, Detectors and Mixers; Amplifiers: Small signal amplifiers, Low noise amplifiers, Power amplifiers; Oscillators.

6. Antenna Fundamentals
3L
Antenna parameters, Antenna Types & Arrays: Uniform linear arrays, beamforming, Microstrip antennas (patch antennas), Yagi-Uda, helical, and horn antennas, Antenna impedance and matching types.

7. Simulation, Design Tools and Applications
6L
Use of tools like ADS, HFSS or MATLAB. PCB layout for RF design, Antenna simulation and optimization, Hands-on lab/project work, RF in wireless systems: WiFi, LTE, 5G, IoT and wearable antennas

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CO1	2	2	1	1	-	-	-	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	2	-
CO3	3	3	3	3	2	-	-	-	-	-	2
CO4	3	1	1	1	-	-	-	-	-	-	-
CO4	3	2	1	2	1	-	-	-	-	-	2

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3		
CO3	3	2	-
CO4	3	2	-
CO5	3	3	-

Applications of Nanotechnology
Paper Code: MCE103A
Contacts: 3-0-0
Total Contact Hours: 36
Credits: 3
Prerequisites: Semiconductor Physics, Solid-State Electronics

Course Objectives:

1. To introduce the fundamental principles of nanoelectronics and nanophotonics, including quantum mechanics and nanoscale phenomena.
2. To explore the design, operation, and fabrication of nanoscale electronic and photonic devices.
3. To develop an understanding of emerging technologies and their applications in electronics, communication, and sensing.

Course Outcomes (COs):

- **CO1:** Understand the scope and significance of nanotechnology in electronics and photonics.
- **CO2:**Analyze the principles and operations of nanoelectronic devices.
- **CO3:** Explore the fundamentals and applications of nanophotonic devices.
- **CO4:** Demonstrate knowledge of fabrication and characterization techniques for nanodevices.
- **CO5:** Apply nanoelectronic and nanophotonic concepts to solve real-world problems in energy, health, and communication systems.

Course Contents

Module 1: Fundamentals of Nanotechnology (6L) Introduction to nanotechnology, Relevance and history, Scaling laws and quantum confinement, Types of nanomaterials: Quantum dots, Nanowires, Nanotubes, Thin films, Surface-to-volume ratio, surface energy, interface effects, Applications in nanoelectronics and nanophotonics

Module 2: Introduction to Nanoelectronics (8L) Quantum mechanics review: Wave functions, tunneling, energy quantization, Ballistic transport and quantum capacitance, Metal–Oxide–Semiconductor Field-Effect Transistors (MOSFETs) at nanoscale, Carbon Nanotube FETs, FinFETs, and Tunnel FETs, Quantum Dot and Single-Electron Transistors, Moore's Law and Beyond CMOS technologies

Module 3: Fabrication and Characterization (6L) Nanofabrication techniques: Lithography (Photolithography, E-beam), Etching, Deposition, Top-down vs. bottom-up approaches, Self-assembly and molecular electronics, Thin film growth methods (CVD, ALD, MBE), Characterization tools: AFM, SEM, TEM, STM

Module 4: Fundamentals of Nanophotonics (8L) Light–matter interaction at the nanoscale, Photonic bandgap and Photonic crystals, Surface Plasmon Resonance (SPR), Plasmonics, Semiconductor nanophotonics: LEDs, Laser diodes, Quantum dot lasers, Nanophotonic waveguides, Optical fibers at nanoscale, Metamaterials and metasurfaces

Module 5: Applications of Nanoelectronics and Nanophotonics (8L) High-speed and low-power nanoelectronic circuits, Optical data transmission and integrated photonics, Nanosensors and lab-on-chip systems, Bio-imaging and targeted drug delivery, Photovoltaics:

Nanomaterials in solar energy conversion, Future trends: Quantum computing and neuromorphic nanoelectronics

Text Books:

1. Fundamentals of Nanoelectronics, George W. Hanson, Pearson
2. Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications, Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, Cambridge University Press
3. Introduction to Nanophotonics, Sergey V. Gaponenko, Cambridge University Press
4. Fundamentals of Photonics, Bahaa E. A. Saleh, Malvin Carl Teich, Wiley

Reference Books:

1. Nanoelectronics: Devices and Materials, Nurul T. Islam, CRC Press
2. Principles of Nanoelectronics, Mircea Dragoman, Daniela Dragoman, Springer
3. Nanophotonics, Paras N. Prasad, Wiley-Interscience

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	2	2	1	2	1	1	2	1
CO2	2	2	1	2	3	1	2	1	2	1	1
CO3	2	2	3	2	2					2	1
CO4	2	2	3	3	2	1				2	1
CO5	2	2	2	2	3	2	1	1	1	2	2

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	3	3	
CO2	3		
CO3	3	2	
CO4	3	2	
CO5	3	3	

Detection and Estimation Theory
Paper Code: MCE103B
Contacts: 3-0-0
Total Contact Hours: 40
Credit: 3

Course Outcomes:

1. Understand the mathematical background of signal detection and estimation

2. Use classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.
3. Derive and apply filtering methods for parameter estimation
4. Evaluate and design signal detection and estimation systems using K-L expansion, Wiener-Hopf solutions, and Kalman-Bucy filters in various noise conditions.

Course Content:

MODULE 1 **13L**

Overview of the course, Classical Decision Theory: Binary hypothesis testing: Bayes criterion, NeymanPearson criterion, min-max test, M-ary hypothesis testing: General rule, minimum probability of error decision rule, Gaussian case and associated geometric concepts, Erasure decision problem, Random parameter estimation.

MODULE 2 **14 L**

Non – random parameter estimation: CRLB for non-random parameters, ML estimation rule, asymptotic properties of ML estimates. Linear minimum variance estimation, Least squares methods CRLB for random parameter estimation, condition for statistical efficiency, Multiple parameter estimation, Composite and nonparametric hypothesis testing, Applications, Detection of signals.

MODULE **3**

13L Mathematical preliminaries: K-L expansion and its application to Detection of known and unknown (i.e. with unknown, parameters) signals in AWGN., Detection of signals in colored noise. Linear estimation, Wiener filters and solution of Wiener Hopf Equations, Kalman- Bucy filters, Miscellaneous estimation techniques.

References:

1.Detection , Estimation and Modulation Theory , Part I ,H. L. Van Trees.
2. Decision and Estimation Theory, Melsa&Cohn , MGH publications.
3. Detection of Signals in Noise, A.D. Whalen (Academic Press,1971).

CO-PO Mapping

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

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	1	2
CO3	3	2	2
CO4	3	2	2

Advanced Information Theory
Course Code: MCE103C
Contacts: 3-0-0
Credit: 3

Course Outcomes: After this course students will be able to

CO1: Understand role of random process in statistical signal processing

CO2: Understand signal modelling techniques

CO3: Comprehend the role of Binary Symmetric Channels

CO4: Understand the theory of hypothesis testing

CO5: Comprehend various digital filter design approaches

Course Content

Module 1: Introduction:2L

Brief description of a digital communication system, Cause of errors and need for error control coding, broad classes of error and classes of error correcting codes, general expression of the probability of error in a binary symmetric Gaussian channel, Principle of maximum likelihood decoding

Module 2: Linear algebra: 3L

Groups- definition, order of a group, modulo-m addition and multiplication tables, modulo-m subtraction and division. Fields- Definition, binary field, Galois field. Polynomials- The concept of polynomial expression, addition/subtraction/multiplication/division of polynomials over GF(2). Irreducible polynomials, primitive polynomials. Vector space, subspace, dual space – their properties and interrelations. Numerical exercises with manual computation and by using MATLAB.

Module 3:Linear block code: 6L

Definition of linear block code. Generator matrix, properties of generator matrix. Parity check matrix and its properties. Encoding circuit- operating principle. Syndrome- definition, most likelihood principle of error detection. Syndrome circuit- operating principle. Hamming distance, minimum distance, minimum weight, error detecting & error correcting capabilities. Standard array- construction, error detection with syndrome. Decoder-operating principle.

Module 4: Cyclic code: 7L

Definition, generator polynomial, properties of cyclic code and generator polynomial. Generator matrix, parity check matrix, their properties and interrelations. Design and operation of encoder. Design and operation of syndrome circuit. Design & operation of Meggitt decoder. Simulation test of above for data transmission through Gaussian binary symmetric channel. Cyclic Hamming code.

Module 5: BCH code: 5L

Construction of Galois field GF(2m)- power representation, polynomial representation, n-tupple representation. Properties of GF(2m), conjugate roots, minimal polynomial, determining minimal polynomials. Description of BCH code, encoding, parity check matrix, error trapping and decoding.

Module 6: Convolutional code: 7L

Definition, encoder, generator sequences, generator matrix, principle of constructing code words, numerical examples, code rate, constraint length, fractional rate loss. Finite state machine analysis of coder, state diagramme, code tree, Trellis. Principle of maximum likelihood decoding of convolutional code, Viterbi algorithm, Numerical examples of decoding and error detection/correction using Trellis, numerical examples using Trellis by MATLAB. Simulation test of above for data transmission through Gaussian binary symmetric channel. Distance properties of convolutional codes.

Module 7: Burst error correcting codes: 4L

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.

Module 8: Application:2L

Brief qualitative discussion of practical application of error control in processors, data storage, data exchange between CPU and peripherals, in CDMA etc.

Text Books:

1. Error Control Coding-Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.

2. Error Correcting Coding Theory-Man Young Rhee-1989, McGraw-Hill Publishing.

3. Cryptography and Network Security: Principles and Practice -William Stallings, 2000, PE

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 Edition, 2009, TMH.

6. Principles of Network and Systems Administration, Mark Burgess, John Wiely Remote

7. Fundamentals of Convolutional Coding. - RoftJohannesson and K. S. Zigangirov. - OUP.

8. Information and Coding Theory. – Gareth A. Jones & J. Mary Jones. - Springer.

9. Error Correcting Codes. - Paterson, W. W. and Weldon, Jr. E. J. - Prentice Hall.

10. Applied Coding and Information Theory for Engineers. – Richard B. Wells. – Pearson Education

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		2		2	2		3		1	2
CO2	3	2		2	2	1		2		3	2
CO3	3	2	2			3		2	2	1	2
CO4	3	2	2			3		2		1	2
CO5	3			2							2

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	2	1	
CO2	2	1	
CO3	2	1	
CO4	2	1	
CO5	2	1	

Quantum Communication
Course Code: MCE104A
Contacts: 3-0-0
Total Contact hours: 36
Credit: 3

Course Outcome(s): After completion of the course students will be able to

CO1 Understand the basic idea of quantum computing including background of mathematics and solving complex engineering problems.

CO2Explain the concept of quantum circuits using single and multiple qubit gates and designing of quantum circuits for solving engineering problem including societal and environmental issues.

CO3 Compare between classical and quantum information theory and explain and apply Bell states, Quantum teleportation, Quantum Cryptography in solving engineering problems maintaining proper ethics of professional collaboration.

CO4Implement different quantum algorithms including classical computation on quantum computers like Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search for solving engineering problems.

CO5Predicting noise and error correction including graph states and codes, quantum error correction, fault tolerant computation in designing complex engineering problems leading to their lifelong learning.

Module I: [8L]

Introduction to Quantum Computing:Elementary quantum mechanics:, linear algebra for quantum mechanics,Quantum states in Hilbert space,The Bloch sphere, Density operators, generalized measurements,Probabilities and measurements, entanglement, density operators and correlation.

Module II[6L]

Quantumcorrelations:Bellinequalitiesandentanglement,Schmidtdecomposition,super- dense coding, teleportation,Noise and error correction, Graph states and codes, Quantum error correction, fault-tolerant computation.

Module III

Quantum Circuits: [4L]

Quantum bits,Single qubit gates, multiple qubit gates, design of quantum circuits,Universal set of gates.

Module IV[6L]

Quantum cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. quantumkey distribution,no cloning theorem

Module V [6L]

Quantum gates and algorithms: Classical computation on quantum computers, Relationship between quantum and classical complexity classes,Solovay-Kitaev, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.

Module VI[6L]

Programmingaquantumcomputer:TheIBMQ,codingaquantumcomputerusingasimulator to carry out basic quantum measurement and state analysis.

Text-books

(1)Phillip Kaye,RaymondLaflammeet.al.,AnintroductiontoQuantum Computing, Oxford University press, 2007.1st edition

(2)ChrisBernhardt,QuantumComputingforEveryone,TheMITPress,Cambridge,20201st edition

(3)DavidMcMahon-QuantumComputingExplained-Wiley-Interscience,IEEEComputer Society (2008) , 1st edition

(4)Pittenger A. O., An Introduction to Quantum Computing Algorithms,Springer Nature,1st edition,

References

(1)QuantumComputationandQuantumInformation,M.A.Nielsen&I.Chuang,Cambridge University Press (2013),1st edition

(2)QuantumComputing,AGentleIntroduction,EleanorG.RieffelandWolfgangH.Polak MITpress (2014),1st edition

(3) Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing Ltd. (2012), 1st edition

CO-PO Mapping

	PO 1	PO 2	PO 3	PO4	PO5	PO 6	PO 7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	1	1	-	-	3	2
CO2	3	3	3	3	2	1	1	-	-	3	2
CO3	3	3	2	3	2	1	1	-	-	3	2
CO4	3	3	2	2	2	1	1	-	-	3	2
CO5	3	3	3	3	2	1	1	-	-	3	2

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	1		
CO2			
CO3			
CO4			
CO5	1	1	

Optical Communication and Networks

Course Code: MCE 104 B

Contacts: 3-0-0

Total Contact hours: 36

Credit: 3

Course Outcome(s):

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

CO1. Understand the basic concept of optical fiber communication and underlying physics.

CO2. Perform modest mathematical analysis related to Optical Communication

CO3. Describe the principle and operation of the optical sources and detectors.

CO4. Understand the Optical System Design and Network

CO5. Discuss the elements of WDM networks, SONET/SDH and its potential applications.

Course Content:

Module I: Overview of Optical Fiber Communication [6L]

Introduction, historical development, general system, advantages, disadvantages, Brief introduction to simple optics, Polarization properties of light. Basic principles of optical fiber communications, optical fiber waveguides, Ray theory, Optical fiber materials, photonic crystal, Fabrication Process, Step Index and Graded Index fiber, Fiber Modes and Configurations, Mode theory for circular waveguides, Numerical Aperture, Acceptance angle, cutoff wave length, mode filed diameter.

Module II Transmission characteristics [6L]

Attenuation, absorption, scattering losses, bending loss, dispersion, Intra modal dispersion, Loss- limited and dispersion- limited lightwave systems, Long-haul systems with In-Line Amplifiers, Dispersion compensation techniques , Link Power budget, rise time budget, Power penalties, nodal noise and chirping.

Point-topoint links - System considerations.

Module III: Optical Sources and Detectors [6L]

Introduction to lasers, Simple rate equation modeling of saturation, gain, amplifiers, types of lasers - HeNe, Nd:YAG, diode, Ti-Sapphire, double hetero junction structure, LEDs and ILDs, Characteristics, Driver circuits, P-N diode, P-I-N diode and APD, Photo transistor, Optical Receiver Operation, receiver sensitivity, SNR, eye diagrams, coherent detection, burst mode receiver operation, Analog receivers.

Module IV: Fiber Couplers and Connectors [4L]

Couplers, Isolators, Polarizers, Circulators, Filters, Add/Drop Mux/Demux, Fiber Optic Repeaters,Optical Amplifiers.

Module V: Optical System Design and Components [8L]

Modulation and Demodulation schemes for coherent communication WDM components and devices, Fabry Perot Filters, Mach-Zehnder Interferometer, EDFA.

Multiplexing techniques, System design issues, Link analysis, Intensity modulation/direct detection system. Variable optical attenuators, tunable optical fibers, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators, tunable light sources.

Digital systems: coding and multiplexing mechanism

Module VI: OPTICAL AMPLIFIERS AND NETWORKS [6L]

Optical amplifiers: basic concepts, semiconductor optical amplifiers,Optical Networks: Network topologies, FDDI Networks: -Frame and Token formats, WDM Networks Optical Interfaces, SONET/SDH rings, single-hop networks, multi hop Networks, wavelength routed networks, Optical CDMA

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	2	2	-	-	1	2	3
CO2	2	1	3	3	2	1	-	-	1	3	3
CO3	3	1	3	2	1	1	-	-	1	1	3
CO4	2	3	1	2	3	3	-	-	1	1	3
CO5	3	2	3	2	1	1	-	-	1	1	3

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	2	1	
CO2	2	1	
CO3	2	1	
CO4	2	1	
CO5	2	1	

Advanced Radio Propagation

Course Code: MCE 104C

Contacts: 3-0-0

Total Contact hours: 36

Credit: 3

Prerequisites: E.M Theory, Microwave Engineering, Sensor

Course Outcomes:

CO1: Understand fundamentals of Radio wave propagation.

CO2: Analyze different models and fading phenomena of Radio wave propagation

CO3: Analyze the mechanism of Remote sensing.

CO4: Analyze working principle of various remote sensors.

CO5: Design remote sensors for real life problems.

Course Content:

Module 1 [4L]

Fundamentals of Radio wave propagation, Free space propagation model, Basic Propagation

Mechanisms- Reflection, 2-Ray Model, Diffraction and Scattering, Multipath and Spatial Interference.

Module 2 [2L]

Physical Phenomena and Frequency dependence: Path propagation, Fresnel Ellipsoids, Fee space

attenuation, Frequency selectivity.

Module 3 [4L]

Radio Propagation Model- Path Loss Model, Ray Model, Exponential Decay Model, Rice Model, Karam-

Fung Model, Knife Edge Model

Module 4 [6L]

Introduction to Small- scale Fading, Small-scale Fading Distribution, Log-Normal Fading, Channel

Transfer Function and Impulse Response, delay speed effect Doppler spectrum. Flat fading channel

modeling, frequency selective fading.

Module 5 [6L]

Fundamentals of Remote Sensing, Interactions between propagated wave and the atmospheric medium,

Scattering absorption and radiation of electromagnetic waves in microwave, Introduction to Remote

Sensing, thermal emission and solar refection remote sensing, Atmospheric Widows, imaging

spectrometry, Spectral signature of water and soil atmospheric interaction

Module 6 [6L]

Types and classification of sensors, imaging modes, Characteristics of optical sensors, sensor resolution-

spectral, radiometric and temporal, Characteristics of detectors, Ground station, Data generation, Data

processing & correction, Ground truth Instruments and spectral signature, thermal remote sensing –

thermal sensors, principle of operation, processing of thermal data, applications, Thermal Scanners-

Characteristics and calibration of scanner.

Module 7 [6L]

Airborne and Space borne radar systems basis instrumentation, IRS Satellite Sensors, LANDSAT, SPOT,

IKONOS, Quickbird, Geoeye, Kompsat, Worldview II & III, Microwave sensors and Image

characteristics, Microwave image interpretation, Resolutions - spatial, spectral, radiometric and temporal,

signal to noise ratio, laser interaction with objects. Remote Sensing platforms –-ERS, JERS,

RADARSAT, RISAT –Scatterometer, Altimeter-LiDAR, Types of LiDAR, Application: Factors of

Special Measurement—Sun Angle, Aerosol, Haze Water Vapour

Module 8 [2L]

Applications of Remote sensing- Agriculture, Forest, Soil, Geology, LU/LC, Water Resources, Urban.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2				-	-	3	2	1
CO2	3	3	3				-	-	3	2	1
CO3	3	3	3				-	-	3	2	2
CO4	3	3	3				-	-	3	2	2
CO5	3	3	3				-	-	3	2	3

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	2	1	
CO2	2	1	
CO3	2	1	
CO4	2	1	
CO5	2	1	

Research Methodology and IPR
Course Code : MLC101
Contacts: 2-0-0
Total Contact hours: 24
Credits: 2

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

CO1. Understand research problem formulation

CO2. Analyze research related information

CO3. Follow research ethics and understand the ultimate importance of ideas, concept and creativity

CO4. Importance of IPR for individuals and nations

CO5. Appreciate that IPR protection provides incentive to inventors for further research work

Course Contents:

Module I (6L)

Meaning of research problem, Sources of research problem, Criteria and characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problems, data collection, analysis, interpretation, necessary instrumentations.

Module II (6L)

Effective literature studies approaches and analysis Plagiarism, Research ethics

Module III (6L)

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module IV (6L)

Nature of Intellectual Property: Patents, Design, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual property. Procedure for grants of patents, Patenting under PCT.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2					2		3		1	2
CO2	2					1		2		3	2
CO3	2	2				3		2		1	2
CO4	2	2	2			3		2		1	2
CO5	2										2

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1	2	1	
CO2	2	1	
CO3	2	1	
CO4	2	1	
CO5	2	1	

Constitution of India

Course Code: MCE 181A

Contacts: 2-0-0

Total Contact Hours: 34

Course Outcome: On Completion of this course student will be able to

CO1: Identify and explore the basic features and modalities of Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the centre and state level.

CO3: Differentiate the various aspects of Indian Legal System and its related bodies.

CO4: Understand the role of municipalitites, panchyat and election commission.

Course Content

Module 1: Introduction: 4L

"Constitution"- Historical Background of the Constituent Assembly, Indian Constitution and its Salient Features, the Preamble of the Constitution.

Module 2: Fundamental Rights, Fundamental Duties, Directive Principles of State Policy: 8L

The Right to Equality The Right to Freedom: I (Article 19)

The Right to Freedom: II (Articles 20, 21 and 22)

The Right against Exploitation

The Right to freedom of Religion

Cultural and Educational rights

The Right to Property

The Right to Constitutional Remedies

The Directive Principles

Fundamental Duties

Module 3: Union Government and its Administration 6L

Structure of the Indian Union, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the

constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Module 4: The Machinery of Government in the State 6L Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts

Module 5: The Machinery of Municipalities and Panchayat 6L

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Module 6: Election Commission 4L

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1) Indian Constitution by D.D.Basu, The Publisher, LexisNexis

2) Constitution of India by Subhas C Kasyap, Vitasta Publishing

3) The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi, 2003. 4) Indian Constitution Text Book - Avasthi, Avasthi,Publisher: LAKSHMI NARAIN AGARWAL

CO-PO Mapping

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

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1		1	
CO2		1	
CO3		1	
CO4		1	

Personality Development

Course Code : MCE181 B

Contacts: 2-0-0

Total Contact Hours: 34

COURSE OUTCOMES

CO1. Understanding the concepts of personality and self esteem

CO2. Basic knowledge of attitude and motivation

CO3. Basic skill development for stress management

CO4. Development of leadership quality and positive attitude

MODULE I Introduction to Personality Development (5L)

The concept of personality - Dimensions of personality – Theories of Freud & Erickson-Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis.

MODULE II: Attitude & Motivation Attitude (5L)

Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation

MODULE III: Self-esteem (5L)

Term self-esteem - Symptoms - Advantages - Do's and Don’ts to develop positive self-esteem – Low self esteem - Symptoms - Personality having low self esteem - Positive and negative self esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviours - Lateral thinking.

MODULE IV: Other Aspects of Personality Development (5L)

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics –Good manners and etiquette

MODULE V: Employability Quotient (4L)

Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.

Text Books:

1. Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.

2. Stephen P. Robbins and Timothy A. Judge(2014), Organizational Behavior 16th Edition: Prentice Hall.

Reference Books:

1. Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi.Tata McGraw-Hill 1988.

2. Heller, Robert.Effective leadership. Essential Manager series. Dk Publishing, 2002

3. Hindle, Tim. Reducing Stress. Essential Manager series. Dk Publishing, 2003

4. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001

5. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).

6. Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005.

7. Smith, B . Body Language. Delhi: Rohan Book Company. 2004

CO-PO Mapping

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

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1		1	
CO2		1	
CO3		1	
CO4		1	

Stress Management By Yoga

Course Code: MCE181C

Contacts: 2-0-0

Total Contact Hours: 34

Course objectives: - To provide students to achieve overall health of body and mind and to overcome stress.

Course Outcome:

CO1: Develop healthy mind in a healthy body thus improving social health also

CO.2: Improve efficiency.

Course Content:

Module1: Definitions of Eight parts of yog. (Ashtanga) – aims & objectives of yoga – misconception about yoga. Historical perceptive on yoga

Module2: Yam and Niyam; Do`s and Don'ts in life. Ahinsa, satya, astheya, bramhacharya and aparigraha, Shaucha, santosh, tapa, swadhyay, ishwarpranidhanAsan and Pranayam

Module3: Various yog poses and their benefits for mind &body Module4:Regularization of breathing techniques and its effects-Types of pranayam Module5: Yoga and development of Social qualities of personality – Co-operation – Simplicity – Tolerance – Social adjustments – Yoga and personal efficiency. Improvement of personal efficiency through yoga.

References

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

CO-PO Mapping

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

CO-PSO Mapping

	PSO1	PSO2	PSO3
CO1		1	
CO2		1	
CO3		1	
CO4		1	

Advanced Communication Lab
Code: MCE 191
Contacts: 0-0-3
Credits: 2
Course Objective:
Experiments on hardware/ kits in order to acquire sufficient knowledge and understand practical limitations/ implications of various communication techniques.

Suggested topics are (not exclusive),

1. Detailed receiver and transmitter parameters of a typical radio communication system – SINAD, fidelity, image rejection, modulation sensitivity, transmission bandwidth etc.
2. Data communication through fiber optic link – losses, power budget, stability etc.
3. Sampling, quantization, coding – sampling rate, quantization error, signal bandwidth etc.
4. QPSK, MPSK – signal bandwidth, distinguishability, effect of noise etc.
5. Binary symmetric channel – noise & Pe etc.
6. PC2PC communication – protocol standards, frame/ packet/ UDP structure etc.
7. Multiple channel DSSS – spreading, dispreading, decoding etc.
8. Important characteristics of different types of transmission lines.
9. Impedance measurement of microwave window applying Smith chart.
10. Microwave phase shifter – calibration.

Course Outcomes

On completion of the course students will be able to

1. Analyse the concept of advanced communication techniques and their applications.
2. Demonstrate to the practical methods of the use of generating communication signals.
3. Evaluate practical methods of the use of demodulation communication signals.
4. Develop insight into the relations between the input and output signals in various stages of a transmitter and a receiver.
5. Clearly distinguish between contemporary advanced communication techniques.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	-	1	2	-	-	2	-	-
CO2	3	2	-	1	3	-	2	-	-	1	3
CO3	3	3	3	3	2	2	-	-	1	-	3
CO4	3	2	3	2	1	-	2	-	-	3	2
CO5	3	3	3	-	-	2	3	3	1	-	-

CO-PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	-	2	-
CO2	2	2	1
CO3	-	2	-
CO4	-	2	2
CO5	3	3	2

SEMESTER II

Advanced Digital Signal Processing

Course Code: MCE201
Contact Hours: 3-0-0 (L-T-P)
Total Contact Hours: 36
Credits: 3

Prerequisites: Basic Digital Signal Processing

Course Outcomes (COs):

- **CO1:** Understand advanced concepts in discrete-time signal analysis and processing.
- **CO2:** Analyze signals and systems using multirate signal processing techniques.
- **CO3:** Design and implement adaptive filtering algorithms.
- **CO4:** Apply time-frequency and spectral estimation methods in real-world signal processing.
- **CO5:** Evaluate and apply DSP techniques in advanced applications such as speech, radar, and biomedical systems.

Course Modules

Module 1: Review and Discrete-Time Signal Analysis (6L)

Review of DFT, Z-transform, FFT, Frequency analysis of signals and systems, Digital filter structures and stability, Fixed-point vs floating-point DSP systems

Module 2: Multirate Signal Processing (8L)

Decimation and interpolation, Polyphase decomposition, Multistage and efficient filter banks, Applications: Sub-band coding, sampling rate conversion

Module 3: Adaptive Signal Processing (8L)

Least Mean Squares (LMS) algorithm, Recursive Least Squares (RLS), Convergence analysis, Applications in noise cancellation, echo suppression

Module 4: Time-Frequency Analysis and Spectral Estimation (7L)

Short-Time Fourier Transform (STFT), Wavelet Transform, Non-parametric spectral estimation (Periodogram), Parametric methods (AR, MA, ARMA models).

Module 5: Applications of Advanced DSP (7L)

DSP in speech processing: Feature extraction, coding, Biomedical signal processing: ECG, EEG analysis, DSP in radar and sonar: Matched filtering, Doppler processing, DSP in machine learning and real-time systems.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	2	0
CO2	3	3	0
CO3	3	2	0
CO4	3	3	0
CO5	3	3	2

Course Name: Wireless and Mobile Communication
Subject Code: MCE202
Contacts: 3-0-0
Total contact hour-36
Credits: 3

Prerequisite: Basic knowledge of communication systems and electromagnetic wave propagation is required.

Course Outcomes:
CO1: Understand the fundamentals of cellular communication systems including frequency reuse, handoff, and interference management.
CO2: Analyze and compare multiple access techniques such as FDMA, TDMA, and CDMA in terms of efficiency and application.
CO3: Evaluate the impact of radio propagation phenomena, path loss models, and fading on wireless system performance.
CO4: Design and assess CDMA-based systems including IS-95 and CDMA2000, understanding their architecture and call processing.
CO5: Explain the architecture and key features of advanced wireless technologies including 3G, 4G LTE, 5G, Massive MIMO, and IoT support.
Course Content:

Module 1: Cellular Communication Fundamentals (10L)

Evolution of mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G) mobile cellular networks, cellular system design, frequency reuse, cell splitting, handover concepts, co-channel and adjacent channel interference, interference reduction techniques, methods to improve cell coverage, frequency management and channel assignment, GSM architecture and interfaces, GSM subsystems, GSM logical channels, data encryption in GSM, mobility management, call flows in GSM, 2.5G standards: High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75G standards: EDGE.

Module 2: Spectral Efficiency and Multiple Access Techniques (4L)

Spectral efficiency analysis based on calculations for multiple access technologies, FDMA and CDMA, comparison based on signal separation techniques, advantages, disadvantages and application areas of FDMA and CDMA, wireless network planning, link budget calculations, power spectrum estimation and considerations.

Module 3: Mobile Radio Propagation (6L)

Large-scale path loss, free space propagation model, reflection and ground reflection (Two-Ray) model, diffraction, scattering, practical link budget design using path loss models, outdoor propagation models, indoor propagation models, signal penetration into buildings, small scale fading and multipath propagation, impulse response model, multipath measurements, parameters of multipath channels, types of small-scale fading: time delay spread, flat and frequency selective fading, Doppler spread, fast and slow fading.

Module 4: Equalization and Diversity (3L)

Equalizers in a communication receiver, algorithms for adaptive equalization, diversity techniques: space diversity, polarization diversity, frequency diversity, interleaving for performance enhancement in fading environments.

Module 5: Code Division Multiple Access (5L)

Introduction to CDMA technology, IS-95 system architecture, air interface, physical and logical channels of IS-95, forward link operation, reverse link operation, IS-95 CDMA call processing, soft handoff mechanisms, evolution from IS-95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure, CDMA 2000 physical and logical channels.

Module 6: Higher Generation Cellular Standards (3L)

3G standards including evolved EDGE, enhancements in 4G standards, LTE architecture, representative protocols for LTE, call flow in LTE, Voice over LTE (VoLTE), UMTS architecture and functions.

Module 7: Introduction to 5G and Key Technologies (3L)

Introduction to 5G wireless technology, small cells: past, present and future trends, cellular network coverage and capacity using small cells, interference management techniques in 5G, Device-to-Device (D2D) communication architecture, towards Internet of Things (IoT), spectrum sharing in 5G environments.

Module 8: Massive MIMO (2L)

Concept of Massive MIMO, point-to-point MIMO, virtual MIMO through relaying, multi-user MIMO, architecture and advantages of massive MIMO systems for high-capacity and efficient wireless communication.

References Books:

1. T.S. Rappaport, "Wireless Communications Principles and Practice", PHI.
2. W.C. Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", TMH.
3. Asha Mehrotra, "A GSM system Engineering", Artech House Publishers Bosten, London.
4. ItiSahaMisra, "Wireless Communications and Networks: 3G and Beyond", TMH.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	2	2
CO4	3	3	2
CO5	3	3	3

Cognitive Radio Networks
Paper Code : MCE203A
Contacts: 3-0-0
Total Contact Hours: 40
Credits: 3

Pre-requisites: The students are expected to have basic knowledge on Wireless Communications / Wireless Networks, Communication Engineering.

Course Outcomes:
On successful completion of this course students should be able to:

1) Understand the fundamental concepts cognitive radio networks (CRNs) and design application specific system of CRNs.
2) Compare and analyze different types of spectrum sensing techniques and radio resource management.

3) Design and interpret of various routing protocols used in CRNs and its differences with traditional routing protocols used in Ad-Hoc networks.
4) Explain and implement joint spectrum sensing and data transmission like resource allocation, power allocation and channel assignment with various optimization techniques.
5) Evaluate security issues in CRNs for data transmission along with various energy harvesting modeling in CRNs.

CONTENT:

Module 1: Introduction to 5G wireless networks [4L]: Introduction to cognitive radio networks, spectrum scarcity problem, Dynamic Spectrum Access (DSA), network architectures, Cognitive cycle and components of cognitive radio.

Module 2: Spectrum sensing (SS) in CRN [8L]: Different SS techniques,- energy detection, Matched filter detection, , feature detection, Cyclo-stationary feature detection, likelihood ration test (LRT), GLRT techniques Cooperative SS: Energy Efficient CSS, security threats in CSS, PUEA and SSDF arracks.

Module 3: Joint SS and Data Transmission [10L]: Link layer design and common control channel, resource allocation-power allocation and channel assignment, Optimization Techniques of DSA: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming and stochastic programming.

Module 4: Multi-hop CRN [4L]: Routing protocols, both centralized, and distributed geographic forwarding and probabilistic approaches-outage analysis.

Module 5: Security in CRN data transmission [4L]: Eavesdropping and secrecy outage in CRN, Jamming for eavesdropping protection, jammer selection, ergodic capacity analysis.

Module 6: Energy Harvesting in CRN [4L]: Wireless energy transfer and scavenging, SWIPT concept, linear and non-liner modeling of EH, Circuit design and interfacing RF energy harvesting boards.

Module 7: Application Specific System Design in CRN with Research Challenges[6L]: Wireless Medical Telemetry Services (WMTS), cognitive radio vehicular networks (CR-VANET), CR for emergency communication, CR-IoT, Cross layer design for CRNs.

Books:

1) Principles of Cognitive Radio, EzioBiglieri, Andrea J. Goldsmith, Larry J. Greenstein, H. Vincent Poor, Narayan B. Mandayam, Cambridge University Press, 2013.
2) Dynamic Spectrum Access and Management in Cognitive Radio Networks, Ekram Hossain, DusitNiyato, Zhu Han, Cambridge University Press, 2009
3) Handbook of Cognitive Radio, Editors: Zhang, Wei (Ed.) Springer
4) Optimizing Wireless Communication Systems, Francisco Rodrigo Porto Cavalcanti, Soren Andersson, Springer, 2009.
5) Cognitive Wireless Communication Networks, Editors: Hossain, Ekram, Bhargava, Vijay K. (Eds.) Springer

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		1	1			2		3
CO2	3			3	3		2			1	3
CO3	3	3	3	3	2	2			1		2
CO4	3	3	3	2	3		2			2	2
CO5	3	3	3			2	2	3	1	2	

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	2	
CO3	3	2	2
CO4	3	3	
CO5	3	2	

ADVANCED IMAGE PROCESSING AND PATTERN RECOGNITION
Course Code: MCE 203B
Contacts: 3-0-0
Total contact hours: 36
Credit: 3

Prerequisite:
The candidates should have the basic knowledge of Engineering Mathematics and Statistics.

Course Outcome:
After completion of the course students will be able to
CO1: Understand the basics of Digital Imaging fundamentals and image processing.
CO2: Analyze and compare the importance of filtering techniques for digital image enhancement and Image Compression.
CO3: Explain and apply the classification and clustering algorithms.
CO4: Understand and explain the importance of feature selection and generation.

Course Content:
Part – A: Image Processing
Module 1:Basics of Image Processing: Basic idea of Digital image, a simple image formation model, basic concepts of image sampling and quantization, representing a digital image, concept of pixel, spatial and gray level resolution, some basic relationships between pixels : Neighbors of a pixel, Adjacency, Connectivity, Path, Connected component, Connected component labeling. Distance measures: the three essential properties, Euclidean, City-Block and Chess-Board distance. [8L]

Module 2: Image Enhancement: Importance of Digital Image enhancement, enhancement in spatial and frequency domain, Spatial domain technique: contrast stretching, basic point processing,

thresholding function, gray-level slicing, bit-plane slicing. Histogram, Histogram Equalization, Basics of spatial filtering, smoothing (averaging) filter/ low pass filter. Frequency domain filtering in Digital Images – LPF, HPF and BPF [8L]

Module 3:Digital Image Compression: Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression. [2L]

Module 4: Segmentation of Digital Images: Importance and applications of Digital Image Segmentation, Detection of discontinuities, Importance of Edge detection, Types of Edge Detection-sobel, canny and prewitt edge detection techniques, Image segmentation by global and local gray level thresholding, region growing, region splitting and merging techniques. [6L]

Part – B: Pattern Recognition

Module 5:Pattern, Clustering and Classification: Concept of a pattern, feature, feature vectors and classifiers. Importance of pattern recognition. Basic concept of cluster analysis. Similarity (Proximity) metrics (indices) and clustering criteria. Partitional clustering: Extraction of natural groups that are inherent in some data set by hard c-means (k-means), fuzzy c-means. Definition of classification. Basic task of a classifier. Concept of training & testing data and over fitting. [6L]

Module 6:Feature Selection and Generation: Introduction, Feature Selection Based on Statistical Hypothesis Testing, Class Separability Measures, Feature Subset Selection, Optimal Feature Generation, Data Transformation and Dimensionality Reduction, Basis Vectors and Images , The Karhunen-Loeve Transform , The Singular Value Decomposition , Independent Component Analysis, Nonnegative Matrix Factorization [6L]

TEXT BOOK:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.
2. S. Annadurai, R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, 2006
3. Digital Video processing, A Murat Tekalp, Prentice Hall 4. Video Processing and Communications, Yao Wang, J. Osternann and Qin Zhang,Pearson Education
4. Pattern Recognition by Sergios Theodoridis and Konstantinos Koutroumbas, Elsevier
5. Pattern Recognition Statistical, Structural and Neural Approaches by Robert Schalkoff, Wiley
6. Pattern Recognition and Machine Learning by Christopher Bishop, Springer

CO-PO Mapping:

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	2	
CO2	3	2	
CO3	3	3	
CO4	3	2	
CO5	3	2	

Data Communication and Network Security

Paper Code: MCE203C

Contacts: 3-0-0

Total contact hours: 36

Credit: 3

Prerequisite: The candidates should have the basic knowledge of communication and hardware

Course Objective: To provide foundational knowledge of data communication, networking protocols, and architectures, along with essential concepts of network security to ensure reliable and secure data exchange.

Course Outcome:

After successful completion of this course, students should be able to:
CO1: Understand the basic concepts of data communication, transmission media and network topologies.
CO2: Apply appropriate transmission methods and protocols for efficient & secure data communication.
CO3: Analyze various network devices, protocols, reference models and routing algorithms.
CO4: Evaluate network security threats and implement suitable cryptographic and security mechanisms to mitigate them.

Course Content:

Module I [8L]
Introduction; network criteria, physical structure and topologies, categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study, Transmission

media: Guided (mainly optical fiber-construction and advantages) & Unguided (including waves); switching techniques: circuit switching, message switching and packet switching; multiplexing: TDM, FDM and WDM

Module II [8L]

Bit communication between DTE and DCE, RS232; Types of errors, framing (character and bit stuffing), error detection & correction methods; Framing and Flow control; Protocols: Stop& wait ARQ,Go-Back- N ARQ, Selective repeat ARQ, HDLC. Point to Point Protocol, Token Ring; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Ethernet: Types and Frame formats

Module III [8L]

Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; IP Addressing: IPv4 and IPv6; Subnet and Supernet; Routing techniques: static vs. dynamic routing, Routing delivery schemes, Source and Hop-by-Hop routing (Dijkastra, Bellman Ford Algorithm), Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, RARP, ICMP, Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Leaky bucket algorithm, Token bucket algorithm

Module IV [6L]

Application layer protocols: DNS, SMTP, SNMP, FTP, HTTP & WWW; Modern technologies: ATM, DSL technology, Wireless LAN: IEEE 802.11(WSN), Introduction to blue-tooth and WiFi, Overview of Mobile IP: Tunneling and Encapsulation, advantages and limitations (in brief)

Module V [6L]

Different aspects of network security: Privacy, Authentication, Integrity and Non-Repudiation. Introduction to Cryptography: Public and Private Key cryptography, Algorithms-DES, AES, RSA, Digital Signature, VPN, Firewalls- types and comparison. Internet services: Email, Internet telephony, Short Messaging Services (SMS), Internet Fax, Video Conferencing, Cyber Security: Introduction, types of attacks, Security tools

Reference Books

1) B.A. Forouzan–"Data Communications and Networking" (3rd Ed.) –TMH
2) A.S. Tanenbaum –"Computer Networks (4thEd.)"–Pearson Education/PHI
3) W. Stallings–"Data and Computer Communications"–PHI/Pearson Education
4) Zheng &Akhtar, Network for Computer Scientists & Engineers, OUP
5) Black, Data & Computer Communication, PHI
6) Shay, Understanding Data Communication & Network, Vikas

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	3	2	1	2	3	1	2	1	1
CO2	2	3	1	2	3	1					1	1
CO3	2	3	3	2	2	1					1	1

CO4	2	3	2	3	2	1					2	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	
CO3	3	2	2
CO4	3	3	
CO5	3	3	2

Artificial Intelligence & Machine Learning

Paper Code: MCE 204B
Contacts: 3-0-0
Total Contact Hours: 40
Credit: 3

Course Content:

Module I [8L]

Definition of AI, Agents and environment, Knowledge, Information, Data, Knowledge based system, Expert System, Data driven and goal driven search- Breadth-first search, Depth first search, Bidirectional search, Greedy Search, A* Search, Hill climbing, simulated annealing, Propositional logic, first order predicate logic (FOPL), Rule of inference, Bayes' rule and Bayesian Networks.

Module II [4L]

Definition of Machine learning system, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation, concept of different learning systems.

Module III [7L]

Introduction to regression, Simple linear regression, Evaluation metrics in regression model, Multiple linear regression, Non-Linear regression, Sum of squared errors, polynomial regression, Least square method, Weighted Least Squares method, Gradient descent algorithm, Effect of bias and variance, overfitting, underfitting.

Module IV [10L]

Classifiers based on Baye's decision theory: Bayesian classification for normal distribution, Bayesian inference. Estimation of unknown probability distributions. Baye's error. Logistic Regression, Entropy, Information Gain, Decision Tree classifier, K-NN classifier, The peceptron algorithm. Support Vector Machine (SVM): separable and nonseparable classes. An introduction to nonlinear classifiers: the XOR problem, the two layer perceptron and

radial basis function (RBF) network. Confusion matrix, different measures related to classification.

Module V [6L]

Basic concept of cluster analysis, applications of cluster analysis, Different clustering algorithms: k-Means, Density based clustering, Hierarchical clustering, Cluster validity.

Module VI [5L]

Introduction to recommendation system, Collaborative Filtering, Content based recommender systems. Application Areas: Qualitative discussions on different application areas of AI and Machine Learning e.g. Image pattern recognition

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	
CO3	3	2	2
CO4	3	3	
CO5	3	3	2

Course Name: Engineering optimization Techniques
Paper Code:MCE204C
Contact (L: T: P): 3 : 0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:

- **Calculus**(especially multivariable calculus)
- **Linear Algebra**
- **Basic Understanding of Engineering Systems**(helpful for application-based modules)

Course Objectives

1. To provide students with a comprehensive understanding of the fundamental concepts and classifications of optimization problems and their significance in engineering.
2. To introduce and develop proficiency in classical unconstrained optimization techniques such as steepest descent, Newton's method, and quasi-Newton methods.
3. To familiarize students with linear programming formulation, graphical and simplex methods, and introduce the principles of duality.
4. To equip students with the ability to solve transportation and assignment problems using standard heuristic and optimization methods.
5. To develop knowledge of nonlinear and integer programming concepts including Kuhn-Tucker conditions and branch and bound techniques.
6. To enable students to apply optimization methods to practical engineering problems through case studies in structural design, control systems, and resource allocation.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:
CO1 Apply unconstrained optimization techniques such as steepest descent, Newton's method, and quasi-Newton methods for solving real-world problems.

CO2. Formulate and solve linear programming problems using graphical methods, the simplex algorithm, and duality concepts; analyze and interpret results for effective decision-making.

CO3. Applying methods such as the North-West Corner Rule, Least Cost Method, Vogel's Approximation Method, MODI method, and the Hungarian algorithm solve transportation and assignment problems.

CO4. Apply Kuhn-Tucker conditions for solving constrained nonlinear optimization problems and understand the fundamentals of integer programming, including the branch and bound method.

CO5. Demonstrate the application of optimization techniques in engineering systems such as structural design, resource allocation, and scheduling through case studies and practical examples.

Course Content:

Module I: Introduction to Optimization (10 Classes)
Definition and classification of optimization problems along with their significance in engineering applications. Focus on unconstrained optimization techniques, including gradient-based methods such as steepest descent, Newton's method, and quasi-Newton methods. Introduction to constrained optimization using the method of Lagrange multipliers.

Module II: Linear Programming and Related Problems (12 Classes)
Formulation techniques for linear programming problems, graphical method for two-variable cases, and the simplex algorithm for solving general linear programs. Concept of duality in linear programming and its implications. Introduction to transportation problems with methods like North-West Corner Rule, Least Cost Method (Matrix Minima), and Vogel's Approximation Method (VAM) for obtaining an initial feasible solution, followed by the MODI method for optimization. Assignment problems and their solutions using the Hungarian method.

Module III: Nonlinear and Integer Programming *(5 Classes)*
Kuhn-Tucker conditions for constrained nonlinear optimization problems, basic principles of integer programming and its significance in discrete decision-making. Introduction to the branch and bound method as a solution technique for integer programming problems.

Module IV: Applications of Optimization in Engineering *(9 Classes)*
Applications of optimization in structural design, optimal control systems, resource allocation, and scheduling. Illustration of engineering design optimization through case studies and examples from various engineering disciplines.

Textbooks

1. **S. S. Rao**, *Engineering Optimization: Theory and Practice*, 4th Edition, Wiley India
2. **Kalyanmoy Deb**, *Optimization for Engineering Design: Algorithms and Examples*, PHI Learning

Reference Books

1. **D. G. Luenberger and Yinyu Ye**, *Linear and Nonlinear Programming*, 3rd Edition, Springer
2. **H. A. Taha**, *Operations Research: An Introduction*, 10th Edition, Pearson
3. **Panneerselvam R.**, *Operations Research*, 2nd Edition, PHI Learning
4. **Edwin K. P. Chong and Stanislaw H. Zak**, *An Introduction to Optimization*, 4th Edition, Wiley
5. **B. E. Gillett**, *Introduction to Operations Research: A Computer-Oriented Algorithmic Approach*, McGraw-Hill

CO-PO Mapping:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	2	3	2	-	-	-	-	-	-	1
CO2	3	3	3	3	1	-	-	-	-	1	1
CO3	3	3	3	2	-	-	-	-	-	-	1
CO4	3	3	3	2	-	-	-	-	-	-	1
CO 5	3	3	3	3	2	1	-	-	-	2	1

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	2	1

CO2	3	2	
CO3	3	2	2
CO4	3	3	
CO5	3	3	2

Course Name: Wireless and Mobile Communication Lab

Course Code: MCE292

Contact hour: 0:0:3

Total contact hours: 36

Credits: 2

Prerequisite

Basic knowledge of wireless communication principles and optical fiber communication is required.

Course Objectives:

The objective of this lab is to provide practical exposure to wireless, mobile, and optical communication systems by conducting experiments on GSM handsets, GPS, ISM band radios, and fiber optic links. It aims to develop students' ability to analyze communication parameters, measure system performance, and implement key components of software-defined radios in real-time environments.

Course Outcome:

CO1: Demonstrate the functionality of satellite repeaters and GSM handset modules by performing practical experiments.

CO2: Analyze GPS signal parameters such as SNR and satellite positions to interpret performance of satellite-based navigation systems.

CO3: Measure and evaluate key parameters of radio transmitters and receivers, including SNR, distortion, and VSWR using ISM band radios.

CO4: Develop and implement basic building blocks of software-defined radios in a simulated or real-time environment.

CO5: Conduct optical fiber experiments to assess transmission losses, multiplexing techniques, and numerical aperture.

List of Experiments:

1. Study of working of Repeater stations with the help of Satellite communication system

2. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

3. Study of Global Positioning System (GPS) and plotting of active satellites with SNR etc.

4. Measurement of some important receiver parameters of a radio receiver like:

i) SNR, ii) Distortion with ISM band radio.

5. Measurement of some important transmitter parameters of a radio receiver like: VSWR for i) different antennae and ii) at different frequencies with ISM band radio.

6. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.

7. Measurement of wavelength of an optical fiber source

8. Measurement of propagation loss, bending loss and connector loss in an optical fiber

9. Study of a fiber optic analog link, study of PAM

10. Study of Frequency Division Multiplexing (FDM) and De multiplexing

11. Study of a fiber optic data link and study of TDM

12. Measurement of numerical aperture of an optical fiber

CO-PO-PSO Mapping

COs	PO1	PO2	PO3		PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2		-	2	-	-	-	2	2	-	3	2	-
CO2	3	3	2		2	2	-	-	-	-	2	-	3	2	-
CO3	3	3	3		2	3	-	-	-	-	-	-	3	3	-
CO4	3	3	3		2	3	-	-	-	-	-	-	3	3	2
CO5	3	2	2		2	2	-	-	-	-	-	-	3	3	-

Advanced VLSI Technology
Course Code: MCE301A
Contacts: 3-0-0
Total Contact Hours: 36
Credits: 3
Prerequisites: Digital Electronics, Semiconductor Physics, VLSI Design

Course Objectives:

1. To introduce the methodologies and algorithmic foundations essential for VLSI design automation and CAD tool development.
2. To provide in-depth knowledge of physical design processes, including layout compaction, placement, partitioning, floor planning, and routing techniques.
3. To develop an understanding of digital circuit modeling, simulation, and synthesis at both logic and high levels of abstraction.
4. To familiarize students with the fabrication processes and technological aspects of VLSI systems, including CMOS process flows.

Course Outcomes (COs):

- **CO1**: Understand VLSI design automation methodologies and foundational algorithmic concepts relevant to CAD tool development.
- **CO2**: Analyze and apply algorithms for layout compaction, placement, and partitioning in physical design automation.
- **CO3**: Explore and implement floor planning and routing techniques for efficient chip design.
- **CO4**: Demonstrate the ability to model, simulate and synthesize digital circuits using logic and high-level synthesis methodologies.
- **CO5**: Understand the microelectronics technology and fabrication processes used in modern VLSI systems, including CMOS technologies.

Course Contents

Module I: VLSI Design Methodologies and Algorithm Foundations (7 L)
Introduction to VLSI Design Automation and Methodologies, Review of Data Structures and Algorithms used in CAD tools, Algorithmic Graph Theory in VLSI context, Computational Complexity: Tractable vs. Intractable problems, Combinatorial Optimization Techniques in VLSI

Module II: Layout Compaction, Placement & Partitioning (7 L)
Layout Design Rules and Compaction, Constraint Graph Formulation, Algorithms for Layout Compaction, Circuit Representation for Physical Design, Placement Techniques and Algorithms, Partitioning Methods and Heuristics

Module III: Floorplanning and Routing Techniques (7 L)

Floorplanning Basics: Terminologies and Representations, Shape Functions and Floorplan Sizing, Routing Overview: Types and Classifications, Local and Global Routing Problems, Area and Channel Routing, Global Routing Algorithms (e.g., Maze Routing, Line-Probe Algorithms)

Module IV: VLSI Modeling, Simulation and Logic Synthesis (7 L)
Gate-Level and Switch-Level Modeling & Simulation, Combinational Logic Synthesis Concepts, Binary Decision Diagrams (BDDs), Two-Level Logic Synthesis Techniques, Introduction to High-Level Synthesis (HLS), Scheduling and Allocation in HLS, Assignment Problems and Optimization in HLS

Module V: Microelectronics Technology and VLSI Fabrication (8 L)
Overview of Unit Processes in VLSI, Wafer Preparation and Crystal Growth, Oxidation, Diffusion, and Ion Implantation, Deposition Techniques: CVD, PVD, Metallization and Etching, Lithography: Photolithography, Challenges at Advanced Nodes, nMOS Fabrication Process Flow, n-Well and p-Well CMOS Fabrication Processes

Text Books:

5. Algorithms for VLSI Design Automation, S.H. Gerez, Wiley
6. CMOS VLSI Design: A Circuits and Systems Perspective, N.H.E. Weste and D. Harris, Pearson
7. Synthesis and Optimization of Digital Circuits, Giovanni De Micheli, McGraw-Hill
8. Physics of Semiconductor Devices, S.M. Sze and Kwok K. Ng,, Wiley

Reference Books:

4. CMOS Digital Integrated Circuits: Analysis and Design, S. Kang and Y. Leblebici, McGraw-Hill
5. Modern VLSI Design: System-on-Chip Design, Wayne Wolf, Pearson

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	1	-	-	-	-	-
CO3	3	3	3	3	3	2	-	-	-	-	-
CO4	3	3	3	3	3	2	-	-	-	-	-
CO5	3	3	3	3	3	3	-	-	-	-	-

CO-PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	3	1
CO3	3	2	-
CO4	3	2	2
CO5	3	3	2

Device Modelling & simulation techniques
PaperCode:MCE301B
Credit: 3-0-0
Total Contact Hours: 40

Prerequisites: Engineering Mathematics, Basics of Semiconductor Devices, Digital Electronics, Neural Network

Course Outcome:

CO1: Ability to understand the techniques of modelling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems through available software.

CO2: Ability to analyse and design combinational and sequential digital systems using VHDL, Verilog. SPICE.

CO3: Students will learn to Model any kind of MOS Devices in 2-D.

CO4: Students learn about neural network modelling, optimisation and design of systems.

CO5: Students will learn different types of simulation techniques

Course Content:

Module I:Introduction: System, environment, input and output variables, State variables; Static and Dynamic systems; Hierarchy of knowledge about a system and Modelling strategy. [4L]

Module II:Modelling Digital System, Design Methodology, Hardware Description Language.HDL modelling of combinational Circuits, Combinational Components and Circuits, Decoders and encoders, Multiplexers and De multiplexers, Priority encoder, Priority decoder, Comparators, Adders. [8L]

Module II: MOSFET Modelling in VLSI: Long-Channel MOS Transistor, Introduction All-Region Models, Strong Inversion Models, Weak Inversion Models, Source Reference vs. Body Reference, Effective.Small-Signal Modelling - Conductance Parameter Definitions and Equivalent Circuits, Conductance Parameters Due to Gate and Body Leakage, Trans conductance, Source-Drain and Output Conductance, Capacitance Definitions and Equivalent Circuits [10L]

Module III:**Optimizations and Design of Systems**: Summary of gradient based techniques: Non-traditional Optimizations techniques (1) genetic Algorithm (GA)- coding, GA operations elitism, Application using MATLAB:(ii) Simulated Annealing. [8L]

Module IV: Neural Network Modelling of Systems only with Input-output Database: Neurons, architecture of neural networks, knowledge representation, learning algorithm. Multilayer feed forward network and its back propagation learning algorithm, Application to complex engineering systems and strategy for optimum output. [5L]

Module V:Simulation of Engineering Systems: Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable examples from engineering problems. [5L]

Textbooks:

1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2 nd Edition. Academic press 2000
2. Shannon, R. E., “System Simulation: the Art and Science”, Prentice Hall Inc. 1990 5
3. Pratab.R " Getting started with MATLAB" Oxford university Press 2009.
4. Y. Tsividis and C. McAndrew, MOSFET modelling for Circuit Simulation, Oxford University Press, 2011

Reference Books:

1. T. A. Fjeldly, T. Yetterdal and M. Shur, Introduction to Device Modeling and Circuit Simulation, John Wiley, 1998.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3									
CO2	3										
CO3	3		3		3						
CO4	3			3	3						
CO5	3		3		3		3	3	3		3

CO-PSO Mapping:

	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	3	1
CO3	3	2	-
CO4	3	2	2
CO5	3	3	2

Information Security &Risk Management Course

Code: MCE301C

Contacts: 3:0:0

Total Contact Hours: 36 Credit: 3

Prerequisite:

A basic understanding of information security and information security management topics is helpful for students attending this class. However, a strong background in any of these skills is not a pre-requisite for the class.

Course Outcome:

Postgraduate students of ECE Program will be able:

CO1: To analyze IT-security with the requirements of standards;

CO2: To apply actual IT-security standards in the field of IT-security risk management;

CO3: To prepare written and oral presentation materials on professional activities;

CO4: Independently set research tasks, develop experiments plans, provide data collection.

Explain how risk is assessed based on the likelihood of adverse events and the effects on information assets when events occur.

CO5: Recognize the strategy options used to control risk and be prepared to select from them when given background information.

Course Contents:

Module I: Information Security [6L]

Fundamentals of information security management - course overview. and expectations. The Threat Assessment Process: Threat Assessment and its Input to Risk Assessment; Threat Assessment Method; Example, Threat Assessment. Goals of Computer Security. CIA triangle, Identifying the Assets, Threats, Impact, vulnerabilities, User Authentication, System Access Control, Password Management, Privileged User Management, User Account Management, Data Resource Protection, Sensitive System Protection, Cryptography, Intrusion detection, Computer-Security Classifications.

Module II: Computer Security [6L]

Hardening (Operating System and Application Code, File System Security, Local Security Policies, Services, Default Accounts), Network Activity, Malicious Code, Firewall , Fault Tolerant System , BACKUP and UPS.

Module III: Network Security [6L]

Network security issues, threats& solutions, cryptography, algorithms (encryption, substitution, sequential and random, transposition), crypto-analysis, methods of breaking these algorithms. Security monitoring: Security monitoring overview and how it can help manage. Overview of security monitoring data, logging requirements, and monitoring tools

Module IV: Disaster Management [6L]

Types of Disaster, Challenge in Global operations, understanding disaster recovery& business continuity, Business Continuity Management, Preparing BCP – a 10 step process, case (eg WTC) Data protection: Identifying critical assets / data classification (data elements, PII, process): Data loss prevention (data in motion, data at rest, and data at endpoint), Data privacy. Privacy laws, data flow, data inventory, integrated framework.

Module V:RiskManagement [7L]

Cyber Threats, including motivation, trends, and threat monitoring ,General principles of risk analysis

,Mechanics of cyber security risk assessment; Risk Management vs Risk Minimisation: Risk Management Principles; DDoS risk assessment, IT risk analysis, risk management (Cyber security Framework), and security risk metrics , Major steps of risk analysis (probability, impact, prioritization, etc.).Approaches to managing risks (reduction, mitigation transfer, and acceptance). Managing risk with metrics, Security Fatigue. Risk Analysis - Analysis Examples/Case studies

Module VI: Security Policies [5L]

Introduction to the Information Security Management (ISM) and Law. The Information Security (IS) program: Security policy, Security policy management, and security governance.Technical Controls; Social Aspects of Information Security; People vs. Cybersecurity, Economic Aspects of Information Security; Business priorities and information security risks. Case studies of analyzing business and technical risks.

Tex Book:

1. D.P.Sharma,E-retailingPrinciplesandPractice,Himalaya Publications
2. Caroll&Broadhead,SellingOnline:HowtoBecomeaSuccessfulE-CommerceMerchant, Dearborn publishers
3. JaniceReynolds,TheCompleteE-CommerceBook:Design,Build,andMaintainaSuccessful Web-Based Business, CMP Media.
4. Dennis,Fenech&Merrilees,E-retailing,Routledge Press
5. Levy&Weitz,RetailingManagement,TataMcGrawHill

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	3
CO2	3	2	-	-	-	-	-	1	-	-	3
CO3	3	2	2	-	-	-	1	-	-	-	3
CO4	3	1	-	-	-	-	-	2	-	-	3
CO5	3	2	2	-	-	-	1	-	-	-	3

CO-PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	1	-	2
CO2	2	-	1
CO3	3	1	-
CO4	2	-	2
CO5	3	1	-

Deep learning & computer vision

Course Code: MCE302A
Contacts: 3-0-0
Total Contact Hours: 36
Credits: 3
Prerequisites: Basic Python Programming, Linear Algebra, Machine Learning

Course Outcomes (COs):

CO1: Understand the foundational concepts and building blocks of deep learning models.

CO2: Apply convolutional neural networks (CNNs) for various image classification tasks.

CO3: Evaluate and optimize the performance of deep learning models using appropriate metrics and tuning techniques.

CO4: Integrate classical computer vision techniques with deep learning models to solve visual recognition problems.

CO5: Design and implement real-world applications using deep learning in computer vision.

Course Contents

Module 1: Foundations of Deep Learning (6L)

Introduction to AI, ML, and DL; perceptron model; feedforward neural networks; activation functions; loss functions; backpropagation; optimization techniques including gradient descent and Adam; overfitting, regularization (dropout, L2), batch normalization.

Module 2: Convolutional Neural Networks (8L)

Basics of CNNs: convolution operation, kernels, padding, stride, and pooling; popular architectures (LeNet, AlexNet, VGG, ResNet); transfer learning; data augmentation; CNN applications in image classification.

Module 3: Training and Evaluation of DL Models (6L)

Model training best practices; hyper parameter tuning (learning rate, batch size, epochs); model evaluation metrics: accuracy, precision, recall, F1-score; confusion matrix; cross-validation in DL; explainability tools (Grad-CAM, feature maps).

Module 4: Classical and Modern Computer Vision (8L)

Introduction to OpenCV; color models, histograms, thresholding; edge detection (Sobel, Canny); object detection techniques: YOLO, SSD; image segmentation: U-Net, thresholding; brief on GANs and their applications.

Module 5: Applications and Deployment (8L)

Case studies: face detection, medical imaging, autonomous vehicles; real-world applications in agriculture, surveillance, healthcare; model compression and quantization; deployment using TensorFlow.

Data Science and Its Applications

Course Code: MCE302B

Contacts: 3-0-0

Total Contact Hours: 36

Credit: 3

Prerequisite:

Students should have a basic understanding of programming concepts, preferably in Python, along with foundational knowledge of mathematics, including statistics and linear algebra.

Familiarity with databases and data structures will also be beneficial for grasping data manipulation and analysis techniques.

Course Objectives

This course aims to introduce students to the core concepts, tools, and techniques of data science for extracting actionable insights from data. It also focuses on applying data-driven solutions across various domains while addressing ethical and privacy concerns.

Course Outcomes:

CO1: Understand the fundamental concepts of data science, its life cycle, and distinguish it from related fields like machine learning and data analytics.
CO2: Apply data collection, cleaning, and preprocessing techniques to prepare raw data for analysis in real-world scenarios.
CO3: Perform exploratory data analysis and visualize complex datasets using statistical and graphical methods to extract meaningful patterns.
CO4: Develop and evaluate machine learning models for classification, regression, and clustering tasks using appropriate algorithms and metrics.
CO5: Analyze and implement data science solutions across various domains such as healthcare, finance, agriculture, and transportation, while considering ethical and privacy implications.

Course Content

Module 1: Introduction to Data Science [6L]
Definition and significance of Data Science, Data Science vs Data Analytics vs Machine Learning, Data Science Life Cycle (DSLC), Tools and Technologies (Python, R, Jupyter), Roles of Data Scientist, Data Engineer, Data Analyst, Applications in Business Intelligence, Applications in Social Media Analytics

Module 2: Data Collection and Preprocessing [6L]
Data types (Structured, Unstructured, Semi-structured), Data sources (Databases, APIs, Web scraping, IoT), Data Cleaning (Handling missing data, duplicates, outliers), Feature engineering, Feature selection, Data transformation techniques, Normalization methods, Applications in Healthcare data management, Applications in Financial data cleaning

Module 3: Exploratory Data Analysis and Visualization [8L]
Descriptive statistics, Data summarization, Univariate analysis, Multivariate analysis, Data visualization using Matplotlib, Seaborn, Tableau, Power BI, Correlation analysis, Causation analysis, Hypothesis Testing, Dimensionality Reduction using PCA, Dimensionality Reduction using t-SNE, Applications in Customer segmentation, Applications in Market basket analysis

Module 4: Machine Learning for Data Science [10L]
Supervised Learning (Regression, Classification), Unsupervised Learning (Clustering, Association Rules), Model training, Model testing, Model evaluation metrics, Overfitting and underfitting,

Cross-validation, Introduction to Deep Learning, Basics of Neural Networks, Applications in Fraud detection, Applications in Recommendation systems

Module 5: Applications of Data Science in Real-world Domains [6L]

Applications in Healthcare (disease prediction, drug discovery), Applications in Agriculture (crop yield prediction, pest detection), Applications in Education (student performance analysis, e-learning analytics), Applications in Transportation (traffic prediction, route optimization), Applications in Finance (credit scoring, stock market prediction), Case studies, Mini project, Ethical issues in Data Science, Data privacy concerns, Introduction to GDPR, Discussion on algorithmic bias

Reference Books

1) "Data Science from Scratch: First Principles with Python" – *Joel Grus,* **O'Reilly Media**

2) "Python for Data Analysis" – *Wes McKinney,* **O'Reilly Media**

3) "An Introduction to Statistical Learning" – *Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani,* **Springer**

4) "Data Mining: Concepts and Techniques" – *Jiawei Han, Micheline Kamber, Jian Pei,* **Morgan Kaufmann**

5) "Machine Learning with Python for Everyone" – *Mark Fenner,* **Pearson Education**

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2								2	1	1
CO2	3	2			3								3	3	
CO3	3	2	2		3								3	2	1
CO4	3	2	3	3	3								3	3	1
CO5	2		2		2	2	1	3				2	2	1	3

Advanced Embedded Systems
Course Code: MCE302C
Contacts: 3:0:0
Total Contact Hours: 36
Credit:3

Prerequisite: DigitalElectronics,AnalogElectronics,MicroprocessorandMicrocontroller, Sensors, Actuators

Course Objectives:

- Students have knowledge about the basic functions, structure, concepts and

applications of embedded systems.

- Develop familiarity with Microcontrollers and their applications in an embedded environment.
- To learn the method of designing and program an Embedded Systems for real time applications.
- To understand operating system concepts, types and choosing RTOS.
- Students have knowledge about the development of embedded software using RTOS

CourseOutcomes:

Graduatesofthe ECEprogramwillbe ableto:

CO1: Understand basic concept of embedded systems.
CO2: Integratingthememories withthe embeddedprocessors
CO3: Integrating sensorsandactuatorswiththeprocessors
CO4: Experimentingparallelandserialcommunicationwiththeprocessorsthroughhighspeed wirelessdeviceslikeZigbee,Bluetooth,GSMmodulesetc.
CO5: Solvingreal timeprojectswhichmaybebeneficialtothesociety

Course Content:

Module1:[5L]

INTRODUCTION TO EMBEDDED SYSTEMS:
Evolution of microprocessors and embedded systems. General purpose computers vs Embedded systems. Performance and power consumption, Moore's law, Amdahl's law. ARM. Classifications: RISC, CISC, Flynn's Classification, Big and little endian CPI. Computer Architecture: Pipelining stages, Superscalar processing, Throughput and latency.

Module2:

INTRODUCTION TO EMBEDDED SYSTEMS HARDWARE AND SOFTWARE:[5L]

Terminology – Gates – Timing diagram – Memory – Microprocessor buses – Direct memory access – Interrupts – Built interrupts – Interrupts basis – Shared data problems – Interrupt latency - Embedded system evolution trends – Interrupt routines in an RTOS environment.

Module3:

EMBEDDED NETWORKING:[5L]

Embedded Networking: Introduction, I/O Device Ports and Buses- Serial Bus communication protocols -RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) -need for device drivers.

Module4:

ARM ARCHITECTURE: Cortex-M3/M4 Microcontroller STM32L15xxx ARM Cortex M3/M4 Microcontroller:[6L]

Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART.

Module5:

OVERVIEW OF CORTEX-M3 CORTEX-M3 BASICS:[7L]

Registers, general purpose registers, stack pointer, link register, program counter, special registers, operation mode, exceptions and interrupts, vector tables, stack memory operations, reset sequence. Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions. Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.

Module6:

CORTEX-M3/M4 PROGRAMMING:[8L]

Typical Development Flow, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.

Textbooks:

1. EmbeddedSystemsArchitecture,Programmingand Design,RalKamal,TMH,2008.
2. IntroductiontoEmbeddedSystems:ShibuK.V.(TMH)
3. AnEmbeddedSoftwarePrimer,D.E.Simon.,PearsonEducation,1999.
4. EmbeddedSystems,SantanuChattopadhaya,Pearson
5. EmbeddedSystems :L.B. Das,Pearson

ReferenceBooks:

1. EmbeddedSystemsDesign,HeathSteve,SecondEdition-2003,Newnes,
2. Computers as Components; Principles of Embedded Computing System Design, Wayne WolfHarcourtIndia,MorganKaufmanPublishers,FirstIndianReprint.2001.
3. EmbeddedSystemsDesign–AunifiedHardware/SoftwareIntroduction,Frank VahidandTonyGivargis,JohnWiley,2002.
4. Design with PIC Microcontrollers,J.B.Peatman,Pearson Education,1998

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO9	PO10	PO11
CO1	3	1	1	-	-	2	-	2	-	-	2
CO2	-	3	2	2	-	1	-	-	1	-	-
CO3	3	2	2	-	1	-	3	-	-	2	-
CO4	3	2	1	-	-	-	2	-	-	-	1
CO5	2	1	2	-	-	3	1	-	-	-	-

CO-PSO Mapping:

	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	3	1
CO3	3	2	-
CO4	3	2	2
CO5	3	3	-