ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

SCHOOL OF ELECTRONIC SCIENCES

Open Elective

B. Tech in Electronics and Communication Engineering

Curriculum and Syllabus
(2023-24 admitted students)

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH
Techno Campus, MahalaxmiVihar,Ghatikia, Bhubaneswar-751029.
Syllabus (Admission Batch: 2023-24)

School/ Department: SCHOOL OF ELECTRONIC SCIENCES
Course: B. Tech **Programme: Electronics and Communication Engineering**
Abbreviation used:

AC	Audit course	LC	Laboratory Course	PA	Practical Assessment
PC	Professional Core	PR	Project/ Practical/ Internship	L	Lecture
PE	Professional Elective	SE	Seminar/ Expert Lecture/ Etc.	T	Tutorial
OE	Open Elective	IA*	Internal Assessment	P	Practical
MC/BS/HS	Mandatory/ Common Course	EA	End-Semester Assessment		
ACC	Advanced Competency Course				
*Internal Assessment Mark (40 marks) consists of (i) Mid Semester (20 marks) (ii) Quiz/ Assignment/Attendance (20 marks)					

OPEN ELECTIVES I (ODD SEM)

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	OE	EI4321	Signals and Systems	3	0	0	3	40	60	-	100
2		EI4323	Digital System Design	3	0	0	3	40	60	-	100
3		EI4325	Digital VLSI Design	3	0	0	3	40	60	-	100

OPEN ELECTIVES II, III & IV (EVEN SEM)

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	OE	EI4322	Communication System Engineering	3	0	0	3	40	60	-	100
2		EI4324	Digital Image Processing	3	0	0	3	40	60	-	100
3		EI4326	Soft Computing	3	0	0	3	40	60	-	100
4		EI4328	Radar and Satellite Communication	3	0	0	3	40	60	-	100
5		EI4330	Wireless Communication	3	0	0	3	40	60	-	100
6		EI4332	Optical Fibre Communication	3	0	0	3	40	60	-	100
7		EI4334	Microprocessor and Interfacing	3	0	0	3	40	60	-	100
8		EI4336	Embedded Systems	3	0	0	3	40	60	-	100
9		EI4338	Information Theory Coding & Cryptography	3	0	0	3	40	60	-	100

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
SIGNALS AND SYSTEMS	EI4321	3-0-0	3

Prerequisite: Calculus, Differential equation, Fourier Analysis.

Course Outcomes:

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

CO1 : Test a given system for linearity/causality/stability/time-invariance.
CO2 : Calculate continuous and discrete signals/systems in time and frequency domains using different transforms.
CO3 : Evaluate the time-domain and frequency-domain representation of a sampled signal.
CO4 : Compute the output of an LTI system in the time and frequency domains.

Module I: **8 Hours**

CLASSIFICATION OF SIGNALS AND SYSTEMS: Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Standard signals- Step, Ramp, Pulse, Impulse, Transformations of the Independent Variable, Real and complex exponentials and Sinusoids, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable, Basic System Properties.

LINEAR TIME-INVARIANT SYSTEMS: Continuous-Time LTI Systems: The Convolution Integral, Properties of Linear Time-Invariant Systems, Causal LTI Systems Described by Differential and Difference Equations, Singularity Functions.

Module II: **8 Hours**

ANALYSIS OF CONTINUOUS TIME SIGNALS: Response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series

CONTINUOUS-TIME FOURIER TRANSFORM: Representation of Aperiodic Signals: Continuous--Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Continuous- Time Fourier Transform, The Convolution Property, The Multiplication Property, Fourier Properties and Basic Fourier Transform Pairs.

Module III: **9 Hours**

TIME AND FREQUENCY CHARACTERIZATION OF SIGNALS AND SYSTEMS: Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems.

LAPLACE TRANSFORM: Laplace Transform, region of convergence for the Laplace transform, the inverse Laplace Transform, Geometric evaluation of Fourier Transform from pole zero plot, Properties of Laplace Transform, Analysis and characterization of LTI system using the Laplace Transform.

Module IV: **5 Hours**

Sampling: Representation of a Continuous-Time Signal by Its Samples: The Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation, The Effect of Under Sampling: Aliasing.

Total lecture hours: **30 Hours**

Text Book:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, ―"Signals and Systems", Pearson, 2015.
2. A NagoorKani, "Signals & Systems", 2nd edition,Mc-Graw Hill,2017

Reference Book:

1. B. P. Lathi, ―Principles of Linear Systems and Signals‖, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, ―Signals & Systems - Continuous and Discrete, Pearson, 2007.

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Syllabus (Admission Batch: 2023-24)

CO-PO-PSO MAPPING

SIGNALS AND SYSTEMS															
Course outcome	**Program Outcomes**											**Program Specific Outcomes**			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	2	2	1	1	0	0	1	0	1	2	2	1
CO2	3	2	2	2	1	1	1	0	0	1	0	1	3	3	1
CO3	2	2	3	2	2	1	0	0	0	1	0	0	3	3	2
CO4	3	3	3	3	2	2	1	0	0	1	0	0	3	2	1
Average	2.75	2.25	2.5	2.25	1.75	1.25	0.75	0.0	0.0	1.0	0.0	0.5	2.75	2.5	1.25
Level of Correlation: 3 - High 2 - Medium 1 - Low															

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Techno Campus, MahalaxmiVihar,Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL SYSTEM DESIGN	EI4323	3-0-0	3

Prerequisite: Basic knowledge of electronic circuits

Course Outcomes:

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

CO1: Investigate the fundamental principles of Digital System Design.
CO2: Develop combinational circuits using VHDL/Verilog.
CO3: Design sequential circuits using VHDL/Verilog.
CO4: Implement the digital systems for FPGA.

Module I: Fundamental Principles of Digital Systems — 08 Hours

Number Systems, Number Base Conversions, Complements, Signed Binary numbers, Binary Codes, Binary Logic, Logic gates.

Gate-level Minimization: Boolean Algebra, Boolean functions, Canonical and Standard forms, Karnaugh maps.

Module II: Combinational Circuit Design — 08 Hours

Design of adders, subtractors, multipliers, decoders, encoders, multiplexers, Demultiplexers, Comparators, Code Converters and implementation using VHDL/Verilog.

Module III: Sequential Circuit Design — 08 Hours

Design of Latches, Flipflops, Shift Registers, Counters and implementation using VHDL/Verilog.

Module IV: Field-Programmable Gate Arrays — 06 Hours

Introduction to Field-Programmable Gate Arrays (FPGAs), FPGA architecture and capabilities, Implementing Digital Systems on FPGAs using VHDL/Verilog.

Total lecture hours: 30 Hours

Text Book:

1. Morris Mano and Michael D. Ciletti, “Digital Design”, 5^{th} Ed., Pearson Education, 2013.
2. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
3. Cem Unsalan, Bora Tar,“Digital System Design with FPGA: Implementation using Verilog and VHDL”, First Edition, McGrawHill.
4. Simon Monk,“ Programming FPGAs Getting Started with Verilog”, First Edition, McGraw-Hill.

Reference Book:

1. C.H. Roth, “Fundamentals of Logic Design”, 5th Ed. Cengage Learning, 2004.
2. John F. Wakerly, “Digital Design-Principles and Practices”, 5th Edition, Pearson Publication.
3. A. Anand Kumar, “Fundamentals of Digital Circuits”, 4th Ed., PHI, 2016
4. Samir Palnitkar, “ Verilog HDL: A Guide to Digital Design and Synthesis”, 2^{nd}Edition , Pearson Publication.

CO-PO-PSO MAPPING

DIGITAL SYSTEM DESIGN															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	2	3	1	2	1	1	2	2	3	3	2	2
CO2	3	2	2	2	2	2	1	1	1	1	2	2	2	2	2
CO3	3	2	2	3	2	2	1	1	1	2	2	2	3	2	2
CO4	3	2	2	3	3	2	1	1	1	2	2	2	3	3	2
Average	3	2	2	2.5	2.5	1.8	1.3	1	1	1.8	2	2.3	2.8	2.3	2
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL VLSI DESIGN	EI4325	3-0-0	3

Prerequisite: Basics of electronic circuits and devices.

Course Outcomes:

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

CO1: Apply the operation, and performance characteristics of CMOS inverters and combinational logic gates, to analyze delay and power dissipation in digital circuits.

CO2: Design various static and dynamic logic gates, flip-flops, and sequential systems while performing accurate timing analysis including setup and hold time measurements.

CO3: Implement efficient arithmetic circuits such as different adder architectures and multipliers, and optimize them for speed, area, and power.

CO4: Compare the design trade-offs, architecture, operation, and timing of memory circuits.

Module I: **08 Hours**

CMOS inverter construction, transfer characteristics; Resistance and capacitance, transient response; Dynamic, short circuit and leakage power analysis; Combinational circuit design and capacitance; Parasitic delay, logical effort and electrical effort; Gate sizing, buffering

Module II: **08 Hours**

Asymmetric gate, skewed gates, ratioed logic; Dynamic gates, domino logic and static timing analysis; Sequential circuits and feedback; Various D flip flop circuits - static and dynamic; Setup and hold time measurement, timing analysis of latch/flip flop based systems

Module III: **08 Hours**

Adders - mirror adder, carry skip adder, carry select adder, square root adder; Multipliers - signed and unsigned arithmetic, carry save multiplier implementation.

Module IV: **06 Hours**

DRAM, SRAM and CAM memory designs

Total lecture hours: **30 Hours**

Text Book:

1. Baker R J, CMOS: Circuit Design, Layout, and Simulation, 4th Edition, John Wiley and Sons (2019).
2. Anantha P. Chandrakasan, Borivoje Nikolic, and Jan M. Rabaey, Digital Integrated Circuits: A Design Perspective, Pearson Education, 2nd Edition.

Reference Book:

1. Uyemura J P, CMOS Logic Circuit Design, 2nd Edition, Springer Books (2005).

CO-PO-PSO MAPPING

DIGITAL VLSI DESIGN															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1	1	1	1	1	1	-	1	3	3	3
CO2	3	3	3	3	1	1	1	1	1	1	-	1	3	3	3
CO3	3	3	3	3	2	1	1	1	1	1	-	1	3	3	3
CO4	3	3	3	3	1	1	1	1	1	1	-	1	3	3	3
Average	3.0	3.0	3.0	3.0	1.3	1.0	1.0	1.0	1.0	1.0	0.0	1.0	3.0	3.0	3.0
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
COMMUNICATION SYSTEM ENGINEERING	EI4322	3-0-0	3

Prerequisite: Basic engineering mathematics, understanding of electronic devices and circuits, signals and systems.

Course Outcomes:

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

- **CO1:** Apply the knowledge of basic components in communication system.
- **CO2:** Analyse basic analog and digital communication systems.
- **CO3:** Evaluate various modulation and demodulation schemes.
- **CO4:** Perform orthogonalization of signal space.

Module I: Introduction to Communication Systems — 06 Hours

Brief history of electronic communication systems, Types of communication systems, Analog vs. digital communication, Classification of signals, correlation and convolution, Fourier series and Fourier Transforms, power and energy spectral densities, signal distortion.

Module II: Amplitude Modulation (AM) — 06 Hours

Generation and demodulation of AM signals, modulator and demodulator circuits, Frequency Division multiplexing, DSB-SC, SSB-SC, VSB signals.

Module III: Angel Modulation — 06 Hours

Frequency Modulation (FM) and Phase Modulation (PM), FM and PM generation and demodulation, interference and bandwidth considerations, comparison of AM, FM and PM.

Module IV: Digital Modulation — 12 Hours

Sampling theorem, aliasing, quantization and encoding, PCM, DPCM and Delta Modulation, Signal space, Orthogonal signals, Generation, Transmission, Reception, Spectrum and Geometrical Representation in the Signal Space of BPSK, DPSK, QPSK, M-ary PSK, BFSK, M-ary BFSK, minimum shift keying (MSK).

Total lecture hours: 30 Hours

Text Book:

1. P Ramakrishna Rao, “Analog Communication”, McGraw Hill, 2011.
2. B.P. Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2010.
3. Simon Haykin and Michael Moher, "Analog and Digital Communications ", John Wiley Student, 5thEdn.
4. Taub & Schilling, “Principles of communication systems”, 4th Edition, McGraw-Hill.

Reference Book:

1. Upamanyu madhow, “Introduction to communication systems”, CUP, 2014.
2. John G. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education India, 2ndEdn.
3. Schaum’s Outlines on “Analog and Digital Communication”, Hwei P Hsu, McGraw Hill, 3rdEdn.

CO-PO-PSO MAPPING

COMMUNICATION SYSTEM ENGINEERING															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	3	2	1	1	1	-	1	1	1	1	3	3	3
CO2	3	2	3	2	1	1	1	-	1	1	1	1	3	3	3
CO3	3	2	3	2	1	1	1	-	1	1	1	1	3	3	3
CO4	3	2	2	2	1	1	1	-	1	1	1	1	3	3	3
Average	3	2	2.8	2	1	1	1	-	1	1	1	1	3	3	3
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL IMAGE PROCESSING	EI4324	3-0-0	3

Prerequisite: Basic knowledge in Digital Signal Processing and Linear Algebra.

Course Outcomes:

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

CO1: Apply the fundamentals of digital image and its processing.
CO2: Articulate image enhancement techniques in spatial and frequency domains.
CO3: Implement the mathematical modeling for image restoration and compression.
CO4: Examine the concept of image segmentation and morphological operations.

Module I: **8 Hours**

Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition.

Image Enhancement in the Spatial Domain: Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters

Image Enhancement in the Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-DDFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

Module II: **8 Hours**

Image Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error(Wiener) Filtering, Constrained Least Squares Filtering.

Image Segmentation: Point, Line, Edge detection, Thresholding, Region Based segmentation, Hough Transform.

Module III: **8 Hours**

Image Compression: Lossy and lossless compression schemes, prediction-based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

Module IV: **6 Hours**

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing.

Total lecture hours: **30 Hours**

Text Book:

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing, Pearson Education, 2003.
2. A.K. Jain, Fundamentals of Digital Image Processing, PHI.

Reference Book:

1. William K Pratt, Digital Image Processing, John Wiley Publishers
2. Milan Sonka , Vaclav Hlavac , Roger Boyle, Image Processing Analysis and Machine Vision, Thompson Learning(1999).

CO-PO-PSO MAPPING

DIGITAL IMAGE PROCESSING															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	1	1	1	1	1	-	-	-	-	3	2	1
CO2	3	3	3	2	2	2	2	2	-	-	-	-	3	3	2
CO3	3	3	3	2	2	2	2	2	-	-	-	-	3	3	2
CO4	3	3	3	2	2	2	2	2	-	-	-	-	3	3	2
Average	3.0	2.75	2.75	1.75	1.75	1.75	1.75	1.75	0.0	0.0	0.0	0.0	3.0	2.75	1.75
Level of Correlation: 3 - High 2 - Medium 1 - Low															

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
SOFT COMPUTING	EI4326	3-0-0	3

Prerequisite: NIL

Course Outcomes:

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

CO1: Apply the foundational concepts of fuzzy sets, fuzzy inference systems, and their real-life applications.

CO2: Illustrate the structure and functioning of various neural network models and their uses.

CO3: Analyze the application of genetic algorithms to solve engineering optimization problems.

CO4: Evaluate and compare different soft computing techniques for intelligent problem-solving.

Module I: Foundations of Soft Computing and Metaheuristics — 08 Hours

Soft Computing: Conventional AI to Computational Intelligence; Soft Computing Constituents and Applications.

Introduction to Non-traditional Metaheuristic Optimization Techniques: Random Optimization, Simulated Annealing, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization, Harmony Search, Memetic Algorithms, Other Evolutionary Algorithms such as Firefly Algorithm, Bee Algorithm, Shuffled Frog Leap algorithm, Bat algorithm etc.

Data Clustering Algorithms: K-Means, Fuzzy C-Means, Mountain Clustering, Subtractive Clustering

Module II: Fuzzy Logic Systems — 08 Hours

Fuzzy Set theory: Fuzzy Sets & Classical Sets; Operations on Fuzzy Sets, Fuzzy Relations, Linguistic Variables.

Membership Functions: Introduction, Features, & Fuzzification, Methods of Membership Value Assignment; Defuzzification.

Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic; Fuzzy Rule Base and Approximate Reasoning, Fuzzy Quantifiers; Fuzzy Inference Systems, Fuzzy Decision Making, Fuzzy Logic Control System; Fuzzy Expert Systems.

Module III: Artificial Neural Networks (ANNs) — 08 Hours

Neural Networks: Fundamental Concepts, Basic Models and Architecture; Machine Learning Using Neural Networks; Associative Memory Networks and their Applications.

Supervised Learning Neural Networks: Perceptron Networks, Radial Basis Function Networks: Back Propagation Neural Network: Architecture, Learning, Applications, & Research Directions; The Boltzman Machine.

Unsupervised Learning Networks: Competitive Learning networks; Kohonen Self-Organizing Networks; Hebbian learning; The Hopfield Network; Counter propagation Networks; Adaptive Resonance Theory: Introduction, Architecture, & Applications; Feed forward Networks; Reinforcement Learning.

Module IV: Genetic Algorithms and Hybrid Soft Computing Systems — 6 Hours

Genetic Algorithms: Introduction to Genetic Algorithms (GA) and their Terminology; Traditional Optimization and Search Techniques vs. Genetic Algorithm ; Operators in Genetic Algorithms; Problem Solving using Genetic Algorithm; Classification of Genetic Algorithms; Hollands Classifier Systems; Genetic Programming; Advantages and Limitations of Genetic Algorithm; Applications of Genetic Algorithm; Applications of GA in Machine Learning. Introduction to Hybrid Systems; MATLAB Environment for Soft Computing Techniques.

Total lecture hours: — 30 Hours

Text Book:

1. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
2. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)

4. Neural Networks and Learning Machines Simon Haykin (PHI)

Reference Book:

1. J.S.R. Jang, C.T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing, Pearson.
2. S.N. Sivanandam and S.N. Deepa, Principles of Soft Computing, Wiley India.
3. Goldberg D.E., Genetic Algorithms in Search, Optimization & Machine Learning, Pearson.
4. B. Yegnanarayana, Artificial Neural Networks, PHI.

CO-PO-PSO MAPPING

SOFT COMPUTING															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	0	0	1	0	0	0	0	0	0	0	1	2	0
CO2	3	2	2	0	2	0	0	0	0	0	0	0	1	2	1
CO3	3	3	3	2	2	0	0	0	0	0	0	0	2	3	2
CO4	3	3	3	3	2	0	0	0	0	0	0	0	2	3	2
Average	3.00	2.50	2.00	1.25	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.50	1.25
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
RADAR AND SATELLITE COMMUNICATION	EI4328	3-0-0	3

Prerequisite: A working knowledge of Electromagnetics and Communication Systems.

Course Outcomes:

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

CO1: Analyze the fundamental principles and operation of various radar systems including radar equation and signal processing.

CO2: Evaluate different types of radar systems such as CW, FM-CW, MTI, pulse Doppler, and tracking radars.

CO3: Examine the architecture, functions, and subsystems of satellite communication systems including telemetry, tracking, and control.

CO4: Calculate satellite communication link budgets considering system noise, power, and environmental effects.

Module I: **7 Hours**

Basics of Radar: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation.

Radar Equation : SNR, Envelope Detector — False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets – sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities.

Module II: **10 Hours**

CW and Frequency Modulated Radar: Doppler Effect, CW Radar — Block Diagram, Isolation between Transmitter and Receiver.

FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics.

MTI and Pulse Doppler Radar: Introduction, Principle, MTI Radar with – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers — Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters.

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono-pulse Tracking Radar.

Module III: **8 Hours**

Architecture of Satellite Communication System: Principles and architecture of satellite Communication.

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command, and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub -system.

Module IV: **5 Hours**

Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Modulation and Multiple Access Schemes:Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA (Basics only)

Total lecture hours: **30 Hours**

Text Book:

1. Introduction to Radar Systems — Men* I. Skolnik, TMH Special Indian Edition, 2nd Ed.Mcgraw Higher Ed -2017
2. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition,2010

Reference Book:

1. Radar Pnnciples, Technology. Applications — Byron Edde, Pearson Education, 2004.
2. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.

CO-PO-PSO MAPPING

RADAR AND SATELLITE COMMUNICATION															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	1	1	1	1	-	1	-	-	3	2	1
CO2	3	3	3	2	2	2	2	1	-	2	-	-	3	3	2
CO3	3	3	3	2	2	2	1	1	-	1	-	-	3	3	2
CO4	3	3	3	3	2	2	1	1	-	2	-	-	3	3	2
Average	3.0	2.8	2.8	2.2	1.75	1.75	1.25	1.0	-	1.5	-	-	3.0	2.75	1.75
Level of Correlation: 3 - High 2 - Medium 1 - Low															

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
WIRELESS COMMUNICATION	**EI4330**	**3-0-0**	**3**

Prerequisite: Signals and System, DSP, Analog and Digital Communication

Course Outcomes:

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

CO1: Analyze the cellular concepts and wireless standards used in mobile communication systems.

CO2: Evaluate signal propagation characteristics and fading phenomena using theoretical and statistical models.

CO3: Evaluate multiple access and modulation techniques, diversity schemes.

CO4: Calculate the performance of modern wireless communication systems using appropriate metrics and real-world standards.

Module I: **08 Hours**

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G 3G, 4G and 5G cellular mobile standards.

Module II: **08 Hours**

Signal propagation- Propagation mechanism, reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading Channels-Multipath and small-scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate. Capacity of flat and frequency selective channels.

Module III: **08 Hours**

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM. Receiver structure- Diversity receivers-selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity Altamonte scheme.

Module IV: **6 Hours**

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing trade off. Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Total lecture hours: **30 Hours**

Text Book:

1. T.S. Rappaport, “Wireless Communications Principles and Practice”, PHI, II Edition, 2006.
2. William Lee,” Mobile Cellular Telecommunications: Analog and Digital Systems”, McGraw Hill
3. Vijay K. Garg, “Wireless Communication and Networking”, Elsevier, Morgan Kaufmann, Reprinted 2012
4.

Reference Book:

1. Vijay K. Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, Fifth Impression 2008
2. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI)

CO-PO-PSO MAPPING

WIRELESS COMMUNICATION															
Course outcome	**Program Outcomes**											**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	-	2	2	-	-	-	2	-	2	3	1	-
CO2	3	3	2	3	3	-	-	-	-	2	-	2	3	3	1
CO3	3	2	3	2	3	-	-	-	2	2	-	2	3	3	1
CO4	3	3	3	2	3	1	1	-	2	2	2	3	3	3	1
Average	3	2.8	2.2	2.3	2.8	1.5	1	-	2	2	2	2.2	3	2.2	1
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
OPTICAL FIBER COMMUNICATION	**EI4332**	**3-0-0**	**3**

Prerequisite: Basic Optical Laws, Maxwell's equations, Wave propagation in free space.

Course Outcomes:

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

CO1: Classify the different modes and structures of optical fibers.
CO2: Analyze various types of losses and dispersion effects that cause pulse broadening.
CO3: Evaluate the operation of optical receivers and the effects of noise on signal detection.
CO4: Identify the functional roles of components in an optical fiber communication system.

Module I: OVERVIEW OF OPTICAL FIBER COMMUNICATION 08 Hours

Introduction to optical fiber communication systems; advantages of optical fiber communications. Optical fiber waveguides – Introduction, ray theory transmission, total internal reflection, acceptance angle, numerical aperture, skew rays. Cylindrical fibers – Modes, fiber materials, fiber fabrication techniques, fiber optic cables. Classification of optical fibers: single-mode fibers, graded-index fibers.

Module II: SIGNAL DISTORTION IN OPTICAL FIBERS 07 Hours

Attenuation mechanisms: absorption, scattering, bending losses, core and cladding losses. Information capacity determination, group delay. Types of dispersion – material dispersion, waveguide dispersion, polarization mode dispersion, intermodal dispersion, pulse broadening. Optical fiber connectors – connector types, single-mode fiber connectors, connector return loss. Introduction to optical fiber splicing.

Module III: OPTICAL SOURCES 10 Hours

Intrinsic and extrinsic materials – direct and indirect band gaps. LEDs: structures (surface-emitting and edge-emitting), quantum efficiency, LED power, light source materials, LED modulation. LASER diodes – modes and threshold conditions, rate equations, external quantum efficiency, resonant frequencies, structures and radiation patterns, single-mode lasers, external modulation, temperature effects.

Module IV: OPTICAL DETECTORS AND RECEIVERS 05 Hours

Physical principles of PIN and APD photodetectors, detector response time, temperature effects on avalanche gain, comparison of photodetectors. Optical receiver operation – fundamental concepts, digital signal transmission, error sources, receiver configuration

Total lecture hours: 30 Hours

Text Book:

1. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, 4th Edition.
2. John M. Senior, "Optical Fiber Communications", Pearson, 3rd Edn.
3. John Gowar, "Optical Communication Systems", Prentice Hall of India, 2nd Edn.

Reference Book:

1. C.K. Sarkar and D C Sarakar, "Optoelectronics and Fibre Optics Communication", New Age International Publishers, 2nd Edn.
2. Ajoy Ghatak, K.Thyagrajan, "Introduction to Fiber Optics", Cambridge University Press.
3. A. Tripathy, "Optoelectronics and Systems", Studium Press.

CO-PO-PSO MAPPING

OPTICAL FIBER COMMUNICATION															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	1	1	1	-	-	-	-	3	2	1
CO2	3	3	3	2	2	2	2	1	-	-	-	-	3	3	2
CO3	3	3	3	2	2	2	1	1	-	1	-	-	3	3	2
CO4	3	3	3	3	2	2	1	1	-	2	-	-	3	3	2
Average	3	2.75	2.75	2	1.75	1.75	1.25	1	-	1	-	-	3	2.75	1.75
Level of Correlation: 3 - High 2 - Medium 1 - Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
MICROPROCESSOR AND INTERFACING	EI4334	3-0-0	3

Prerequisite: Digital Electronics Circuits

Course Outcomes:

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

CO1: Analyze the architecture of microprocessors.

CO2: Evaluate the various addressing modes, instruction sets and timing diagrams of microprocessors to determine the flow of data.

CO3: Develop programs for various microprocessors to provide solutions for real-world control problems.

CO4: Interface various peripherals with microprocessors.

Module I: INTRODUCTION TO MICROPROCESSORS **04 Hours**

Architecture of 8085 as well as its pin configuration, Registers, memory and I/O interfacing, memory address decoding.

Module II: PROGRAMMING THE 8085 **08 Hours**

Instruction sets, instruction format, timing diagram, addressing modes, assembly language programming, stacks and subroutines, counters, time delays.

Module III: INTERFACING PERIPHERALS **08 Hours**

Interrupts, interfacing memory and I/O ports, ADC and DAC, 8255 PPI, Timer/ Counter.

Module IV: ADVANCED MICROPROCESSORS **10 Hours**

Introduction to 8086/ 80286/80486/ Pentium, RISC and CISC processors.

Total lecture hours: **30 Hours**

Text Book:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/ 8080A, Penram International Publishing, 1996
2. K M Burchandi and A K Ray, “Advanced Microprocessors and Peripherals,” 3rd edition, Tata McGraw-Hill Education, 2012, ISBN: 9781259006135.

Reference Book:

1. Douglas V. Hall, Microprocessor and Interfacing: Programming and Hardware, 2nd Edition, McGraw Hill, 1991.
2. Barry B. Brey, The Intel Microprocessors, 8th Edition, Pearson, 2013.
3. John Uffenbeck, The 8086/8088 Family: Design, Programming, and Interfacing, Prentice Hall, 2002.

CO-PO-PSO MAPPING

MICROPROCESSOR AND INTERFACING															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	2	1	1	1	1	1	1	1	1	3	3	3
CO2	3	3	2	3	1	1	1	1	1	1	1	1	3	3	3
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	3
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	3
Average	3	2.5	2.3	2.5	1.5	1	1	1	1	1	1	1	3	3	3
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
EMBEDDED SYSTEMS	**EI4336**	**3-0-0**	**3**

Prerequisite: Digital Electronic Circuits, Hexadecimal Arithmetic, Basic Programming Skills.

Course Outcomes:

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

CO1: Identify various components, characteristics, and attributes of embedded systems.

CO2: Apply appropriate computational models and scheduling algorithms for implementation of embedded systems.

CO3: Analyze Hardware Software co-design and task synchronization issues with reference to embedded systems.

CO4: Design of embedded systems using the concepts of microprocessors and microcontrollers.

Module I: **8 Hours**

Introduction to Embedded system- What is an Embedded System? Classification, Application areas, Purpose of Embedded Systems.

Typical Embedded System- Core of embedded Systems, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other systems components.

Module II: **8 Hours**

Characteristics and Modeling of Embedded Systems-Characteristics and Quality Attributes of Embedded Systems. Computational Models- DFG, FSMD, Issues in Hardware Software Co-design, UML.

Module III: **8 Hours**

Real Time Operating System- GPOS vs RTOS, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization.

EDLC - Embedded Product Development Life Cycle.

Module IV: **6 Hours**

Overview of PIC and AVR family of microcontrollers and RISC based processors.

Examples- Washing Machine, Digital Camera etc.

Total lecture hours: **30 Hours**

Text Book:

1. K. Shibu, Introduction to Embedded Systems, 2nd Edition, TMH, 2009.
2. Raj Kamal, Embedded Systems- Architecture, Programming and Design, 3rd Edition, Mc Graw Hill Education, 2017.

Reference Book:

1. J.W. Valvano, "Embedded Microcomputor System: Real Time Interfacing", Brooks/Cole, 2000.

CO-PO-PSO MAPPING

EMBEDDED SYSTEMS															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	2	1	1	2	1	1	-	-	-	-	3	2	1
CO2	3	3	3	2	2	3	2	1	-	-	-	-	3	3	2
CO3	3	3	3	2	2	3	2	1	-	-	-	-	3	3	2
CO4	3	3	3	2	3	3	2	2	-	-	-	-	3	3	2
Average	3.0	2.75	2.75	1.75	2.0	2.75	1.75	1.25	-	-	-	-	3.0	2.75	1.75
Level of Correlation: 3 - High 2 - Medium 1 – Low															

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
INFORMATION THEORY & CRYPTOGRAPHY	EI4338	3-0-0	3

Prerequisite: Basic Probability Theory, Discrete Mathematics, Fundamentals of Computer Networks

Course Outcomes:

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

CO1: Quantify information metrics such as entropy and information rate for memoryless sources.

CO2: Characterize discrete channels using joint probabilities and calculate capacity for Binary Symmetric Channel (BSC).

CO3: Design Linear Block, Cyclic, and Convolutional Codes for error detection and correction.

CO4: Analyze various cryptographic algorithms including symmetric and asymmetric key cryptography.

Module I: Introduction to Information Theory **8 Hours**

Review of Probability Theory, Introduction to information theory, Uncertainty, self-information, average information, Marginal Entropy, Joint Entropy and Conditional Entropy, Mutual Information, Relationship between entropy and mutual information and their properties.

Module II: Channel Models and Capacity **8 Hours**

Importance and types of various channel models - Channel capacity calculation – Binary symmetric channel, binary erasure channel - Shannon's channel capacity and channel coding theorem - Shannon's limit.

Module III: Source and channel Coding **7 Hours**

Source coding theorem: Huffman coding, Shannon Fano Elias coding, Arithmetic coding

Introduction to Error control codes: Block codes, linear block codes, cyclic codes and their properties, Convolution Codes, Encoder-Tree diagram, Trellis diagram, state diagram, Viterbi Decoding, Trellis coding, Reed Solomon codes.

Module IV: Symmetric and Asymmetric Cryptography **7 Hours**

Classical cryptography: Caesar cipher, monoalphabetic and polyalphabetic ciphers. Modern symmetric encryption: Data Encryption Standard (DES), Advanced Encryption Standard (AES). Asymmetric encryption: RSA algorithm, key generation and security. Diffie–Hellman key exchange, ElGamal encryption.

Total lecture hours: **30 Hours**

Text Book:

1. Behrouz A. Forouzan, Cryptography and Network Security, McGraw Hill
2. R. Bose, Information Theory, Coding and Cryptography, McGraw Hill
3. Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, Wiley-Interscience
4. William Stallings, Cryptography and Network Security, Pearson

Reference Book:

1. Bruce Schneier, Applied Cryptography, Wiley
2. Trappe and Washington, Introduction to Cryptography with Coding Theory, Pearson
3. Wade Trappe, Lawrence C. Washington, Introduction to Cryptography, Pearson
4. Douglas R. Stinson, Cryptography: Theory and Practice, CRC Press

CO-PO-PSO MAPPING

INFORMATION THEORY & CRYPTOGRAPHY															
Course outcome	**Program Outcomes**												**Program Specific Outcomes**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO l	PSO 2	PSO 3
CO1	3	2	1	2	-	-	-	-	-	-	-	-	3	1	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	2	-	-	-	-	-	-	-	3	2	-
CO4	3	2	2	2	2	-	-	-	-	1	-	-	3	2	-
Average	3	2.25	1.75	2	2	-	-	-	-	0.25	-	-	3	1.75	-
Level of Correlation: 3 - High 2 - Medium 1 - Low															