ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

SCHOOL OF ELECTRONIC SCIENCES

B. Tech in Electronics and Communication Engineering

Curriculum and Syllabus

(**2023-24 admitted students**)

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, 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)					

5th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC	EI3121	Digital Communication	3	0	0	3	40	60	-	100
2	PC	EI3123	Pulse and Digital Circuits	3	0	0	3	40	60	-	100
3	PC	EI3125	Digital Signal Processing	3	0	0	3	40	60	-	100
4	PE-I	EI3221	1. Optical Fiber Communication & Devices	3	0	0	3	40	60	-	100
		EI3223	2. Microwave Theory and Techniques								
		EI3225	3. Machine Learning								
		EI3205	4. VLSI Design								
5	HS	BH3401	Business Management	3	0	0	2	40	60	-	100
		BH3403	Entrepreneurship Development								
6	MC	IP3401	Environmental Engineering	3	0	0	2	40	60	-	100
		IP3403	Industrial Safety Engineering								
7	LC	EI3521	Digital Communication Lab	0	0	3	1.5	-	-	100	100
8	LC	EI3523	Pulse and Digital Circuits Lab	0	0	3	1.5	-	-	100	100
9	LC	EI3525	Digital Signal Processing Lab	0	0	3	1.5	-	-	100	100
10	PSI	EI3701	Seminar on SIRE-I	0	0	3	1.5	-	-	100	100
			Total	**18**	**0**	**12**	**22**	**240**	**360**	**400**	**1000**

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Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

6th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC	EI3103	Microprocessor & Microcontrollers	3	0	0	3	40	60	-	100
2	PC	EI3105	Control System Engineering	3	0	0	3	40	60	-	100
3	PE-II	EI3204	1. Computer Networks	3	0	0	3	40	60	-	100
		EI3222	2. Antennas and Propagation								
		EI3224	3. Wireless Sensor Networks								
		EI3216	4. Embedded Systems								
4	PE-III	EI3226	1. Digital Image Processing	3	0	0	3	40	60	-	100
		EI3228	2. Radar and Satellite Communication								
		EI3230	3. Cloud Computing								
		EI3232	4. Introduction to MEMS								
5	HS	BH3401	Business Management	3	0	0	2	40	60	-	100
		BH3403	Entrepreneurship Development								
6	MC	IP3401	Environmental Engineering	3	0	0	2	40	60	-	100
		IP3403	Industrial Safety Engineering								
7	PSI	EI3602	Project for Product Development-I	0	0	6	3	-	-	100	100
8	LC	EI3503	Microprocessor & Microcontrollers Lab	0	0	3	1.5	-	-	100	100
9	LC	EI3522	Advanced Communication & Signal Processing Lab	0	0	3	1.5	-	-	100	100
10	Summer Internship and Research Experience (SIRE - II) *										
			Total	**18**	**0**	**12**	**22**	**240**	**360**	**400**	**1000**

***Minimum 4 weeks of Summer Course / Training / Internship / Skill Course / etc. after 6th Semester**

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

7th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PE IV	EI4221	1. Computer Organization and Architecture	3	0	0	3	40	60	-	100
		EI4223	2. Wireless Communication								
		EI4225	3. Information Theory & Cryptography								
		EI4227	4. Sensor & Transducers								
2	PE V	EI4207	1. Natural Language Processing	3	0	0	3	40	60	-	100
		EI4229	2. Biomedical Signal Processing								
		EI4231	3. Evolutionary Computation Techniques								
		EI4205	4. Introduction to Microfabrication								
3	OE -1		Open Elective – I	3	0	0	3	40	60	-	100
4	ACC3	EI4101	**Advanced Artificial Intelligence**	3	0	0	3	40	60	-	100
5	PSI	EI4701	Seminar on SIRE – II	0	0	6	1	-	-	100	100
6	PSI	EI4601	Project for Product Development – II	0	0	4	2	-	-	100	100
		EI4603	Internship Project – I								
			Total	**12**	**0**	**10**	**15**	**160**	**240**	**200**	**600**

8th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	OE		Open Elective – II	3	0	0	3	40	60	-	100
2	OE		Open Elective – III	3	0	0	3	40	60	-	100
3	OE		Open Elective – IV	3	0	0	3	40	60	-	100
4	PSI	EI4702	Seminar on Project-III	0	0	6	1	-	-	100	100
5	PSI	EI4602	Project for Product Development – III	0	0	4	2	-	-	100	100
		EI4604	Internship Project – II								
			Total	**9**	**0**	**10**	**12**	**12**	**180**	**200**	**500**

FIFTH SEMESTER

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL COMMUNICATION	EI3121	3-0-0	3

Prerequisite: Probability and statistics, Fourier transform, convolution, digital systems, signals and systems.

Course Outcomes:

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

CO1: Evaluate the power spectral density of line codes and the modulation formats.

CO2: Perform orthogonalization of signal space.

CO3: Evaluate the statistical moments of certain probability density functions.

CO4: Design and analyze the performance of baseband and passband receivers using probability of error, threshold detection, and optimum filter design..

Module I: INTRODUCTION **07 Hours**

Sampling Theorem, Flat top sampling, natural sampling, Signal reconstruction from uniform samples, Digital representation of analog signals- Quantization of Signals, Quantization error, Electrical representation of binary digits, PCM systems, Companding, Line Coding, scrambling, Differential PCM.

Module II: DIGITAL MODULATION TECHNIQUES **09 Hours**

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).

Module III: RANDOM VARIABLES **08 Hours**

Random variables, cumulative distribution function, probability distribution function, relation between probability and probability density function, joint cumulative distribution and probability density, a communications example, average value of a random variable, variance of a random variable, Tchebycheff's inequality, the Gaussian probability density, its mean and variance calculation, the Error function, the Rayleigh probability density function.

Module IV: BASEBAND RECEIVERS **06 Hours**

A base band signal receiver, peak signal to RMS noise output voltage ratio, probability of error, optimum threshold, optimum receiver for both base band and pass band: calculation of optimum filter transfer function, optimum filter realization using Matched filter, Probability of error for matched filter, optimum filter realization using correlator, equivalence of matched filtering and correlation.

Total lecture hours: **30 Hours**

Text Book:

1. P Ramakrishna Rao, "Digital Communication" McGraw Hill, 2011
2. Simon Haykin and Michael Moher, "Analog and Digital Communications ", John Wiley Student, 5thEdn.
3. B.P. Lathi, Zhi Ding and Hari Mohan Gupta, "Modern Digital and Analog Communication Systems, Oxford University Press, 4thEdn.
4. Herbert Taub and Donald L.Schilling, "Principles of Communication Systems", Tata Mc Graw Hill, 4thEdn.

Reference Book:

1. John G. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education India, 2nd Edn.
2. Schaum's Outlines on "Analog and Digital Communication", Hwei P Hsu, McGraw Hill, 3rdEdn.

CO-PO-PSO MAPPING

DIGITAL 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 l	PSO 2	PSO 3
CO1	3	2	1	2	2	-	-	-	-	-	-	-	2	1	-
CO2	3	2	2	2	1	-	-	-	-	-	-	-	2	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	1	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	2	2	1
Average	3.0	2.25	2	2	0.75	-	-	-	-	-	-	-	2	1.5	0.25
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
PULSE AND DIGITAL CIRCUITS	EI3123	3-0-0	3

Prerequisite: Basic Electronics, Analog Electronic Circuits

Course Outcomes:

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

CO1: Analyze the response of linear and non-linear wave shaping circuits to different input signals and apply the concepts in signal conditioning applications.

CO2: Design and implement analog signal processing circuits using operational amplifiers including active filters, waveform generators, and data converters.

CO3: Design and evaluate various multivibrator circuits for timing and waveform generation applications using BJT configurations.

CO4: Illustrate the working of negative resistance devices, PLLs, IC 555-based timers and instrumentation amplifiers for time-base generation and frequency synthesis.

Module I: **07 Hours**

Linear Wave Shaping Circuit: High pass and Low pass RC circuits and their response for Sinusoidal, Step, Pulse, Square and Ramp inputs, High pass RC network as Differentiator, Low pass RC circuit as an Integrator.

Non-Linear Wave Shaping Circuit: Diode clippers, Transistor clippers, Clipping at two independent levels, Comparators, Clamping operation, Clamping circuit taking Source and Diode resistances into account, Clamping Circuit Theorem.

Module II: **08 Hours**

Op-Amp and its Applications: Review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: First & Second order low pass / high pass, band pass, band reject, and all pass filters, design guidelines. Universal active filter design, Saw tooth wave generator OP Amps. Voltage Controlled Oscillator.

DAC & ADC: Weighted resistor, R-2R ladder, resistor string etc. Single slope, dual slope, successive approximation, flash ADC. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Module III: Multi vibrator and Triggering circuit **08 Hours**

Bistable Multi Vibrator: Analysis and Design of Fixed Bias, Self-Bias Bistable Multi Vibrator, Collector catching Diodes, Commutating Capacitors, Methods of Triggering using RC network & Diode, Emitter Coupled Bistable Multi Vibrator (Schmitt trigger).

Monostable Multi Vibrator: Analysis and Design of Collector Coupled Monostable Multi Vibrator, Triggering method of a Monostable Multi Vibrator, Application of Monostable Multi Vibrator as a Voltage to Time Converter.

Astable Multi Vibrator: Analysis and Design of Collector Coupled Astable Multi vibrator, Application of Astable Multi Vibrator as a Voltage to Frequency Converter.

Module IV: **07 Hours**

Negative Resistance Switching Devices: Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, Monostable, Astable, Bistable circuits using tunnel diode, Voltage controlled Negative Resistance Switching Circuits.

Time Base Generators and IC Applications: Time-Base Generators, General features of a Time- base signal, IC 555 Timer as a Monostable, astable Multivibrator with its applications. Phase Locked Loop: Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

Total lecture hours: **30 Hours**

Text Book:

1. Pulse and Digital Circuits by A. Anand Kumar, PHI.
2. Pulse, Digital and Switching Waveforms, Second Edition – Jacob Millman, Herbert Taub and Mothiki S Prakash Rao (TMH Publication).
3. Op-Amps and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI Publication).

Reference Book:

1. Pulse and Digital Circuits by K.Venkata Rao, K Rama Sudha and G. Manmadha Rao, Pearson Education, 2010.
2. Op-Amps and Linear Integrated Circuits – Robert F. Coughlin, Frederick F. Driscoll.

CO-PO-PSO MAPPING

PULSE AND DIGITAL CIRCUITS															
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	0	0	0	0	0	0	0	0	0	1	2	0	0
CO2	3	2	3	2	2	0	0	0	0	1	0	1	3	2	0
CO3	3	2	3	1	0	0	0	0	0	1	0	1	3	0	0
CO4	2	1	2	1	0	0	0	0	0	0	0	1	2	2	0
Average	2.75	1.75	2	1	0.5	0	0	0	0	0.5	0	1	2.5	1	0
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
DIGITAL SIGNAL PROCESSING	EI3125	3-0-0	3

Prerequisite: Basic knowledge of Signals and systems, Fourier series and transform differential equations.

Course Outcomes:

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

CO1: Analyze the mathematical operation on discrete signals and systems

CO2: Implement Z transform and the inverse Z transform of discrete signals.

CO3: Analyze DFT, Inverse DFT, and FFT operations on discrete-time signals.

CO4: Model Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, and evaluate the performance to meet expected system specifications.

Module I: **08 Hours**

INTRODUCTION TO DIGITAL SIGNAL PROCESSING: Signals, systems, and signal processing, Classification of signals, The concept of frequency in continuous-time and discrete-time signals, Analog-to-Digital and Digital-to-Analog conversion.

DISCRETE-TIME SIGNALS AND SYSTEMS: Discrete-time signals and Discrete-time systems, Analysis of discrete-time linear time-invariant systems, Discrete-time systems described by difference equations, Implementation of discrete-time systems, Correlation of discrete-time signals.

Module II: **08 Hours**

THE Z-TRANSFORM AND ITS APPLICATION TO THE ANALYSIS OF LTI SYSTEMS: The Direct Z-Transform, The Inverse Z-Transform, Properties of the Z-Transform, Rational Z-Transforms, Poles and Zeros, Pole Location and Time-Domain Behaviour for Causal Signals, The System Function of a Linear Time-Invariant System, Inversion of the Z-Transform, The Inverse Z-Transform by Contour Integration, The Inverse Z-Transform by Power Series Expansion, The Inverse Z-Transform by Partial-Fraction Expansion, Solution of Difference Equations, Analysis of Linear Time-Invariant Systems in the Z-Domain, Response of Systems with Rational System Functions, Response of Pole-Zero Systems with Nonzero Initial Conditions, Transient and Steady-State Responses, Causality, and Stability.

Module III: **09 Hours**

THE DISCRETE FOURIER TRANSFORM: ITS PROPERTIES AND APPLICATIONS: Frequency Domain Sampling: The Discrete Fourier, Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, The Discrete Fourier Transform (DFT), The DFT as a Linear Transformation, Relationship of the DFT to Other Transforms, Properties of the DFT, Periodicity. Linearity. and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties, Linear Filtering Methods Based on the DFT, Use of the DFT in Linear Filtering, Filtering of Long Data Sequences, Frequency Analysis of Signals Using the DFT.

EFFICIENT COMPUTATION OF THE DFT: FAST FOURIER TRANSFORM ALGORITHMS: Efficient Computation of the DFT FFT Algorithms, Radix-2 FFT Algorithms, Implementation of FFT Algorithms, Applications of FFT Algorithms, Efficient Computation of the DFT of Two Real Sequences, Efficient Computation of the DFT of a 2N-Point Real Sequence, Use of the FFT Algorithm in Linear Filtering and Correlation.

Module IV: **05 Hours**

DESIGN OF DIGITAL FILTERS: Design of FIR Filters, Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, by the Frequency-Sampling Method, IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Total lecture hours: **32 Hours**

Text Book:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing, 4th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2007.
2. A. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 3rd ed. Upper Saddle River, NJ,

Reference Book:

1. S. K. Mitra, Digital Signal Processing, 4th ed. New York, NY, USA: McGraw-Hill, 2011.
2. S. Salivahanan, A. Vallabraj, and C. Gnanapriya, Digital Signal Processing. New Delhi, India: Tata McGraw-Hill (TMH) Publishing Co.
3. A. Nagoor Kani, Digital Signal Processing. New Delhi, India: TMH Education.

CO-PO-PSO MAPPING

DIGITAL SIGNAL 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	1	2	2	1	1	1	2	1	2	1	3	1	1
CO2	3	3	1	2	2	1	1	1	2	1	2	1	3	1	1
CO3	3	2	1	2	2	1	1	1	1	1	2	1	3	2	1
CO4	3	3	3	3	3	3	2	1	1	2	2	2	3	2	3
Average	3	2.5	1.5	2.2	2.2	1.5	1.2	1	1.5	1.2	2	1.2	3	1.5	1.5
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
OPTICAL FIBER COMMUNICATION & DEVICES	EI3221	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: Distinguish various modes of operation of optical fibres.

CO2: Calculate different types of losses in optical fibre and the pulse broadening resulting from the effect of dispersion.

CO3: Analyze the operation of optical receiver and various effects introducing noise in the system.

CO4: Elaborate the different elements of an optical fibre link.

Module I: Introduction **08 Hours**

Elements of an Optical Fibre Communication link, Optical Fibre Modes and Configurations, Mode Theory for slab Waveguides, Single-mode Fibres, and Graded-Index Fibre Structure, Numerical aperture.

Attenuation, Signal Distortion in Optical Waveguides, Pulse Broadening in Graded-Index Fiber guides

Module II: Optical Sources and Detectors **07 Hours**

Basic ideas of light sources and their principle of operation (LEDs and LASERS), Physical Principles of Photodetectors, Avalanche Photodiodes.

Module III: Optical Communication Systems **10 Hours**

Optical Receiver Operation (Fundamentals), Receiver noises, Digital Transmission Systems.

Coherent Optical Fiber Communications; Definition and Classification of Coherent System, Fundamental Concepts; Homodyne Detection, Heterodyne Detection, Direct-Detection OOK, OOK Homodyne System, PSK Homodyne System, Heterodyne Detection Schemes.

Module IV: Optical Link Design **05 Hours**

Point-to-Point Links; Link Power Budget, Rise-Time Budget, Transmission Distance for Single-Mode Links, Wavelength Division Multiplexing

Total lecture hours: **30 Hours**

Text Book:

1. G. Keiser, Optical Fiber Communications, 4th ed. New York, NY, USA: McGraw-Hill.
2. J. M. Senior, Optical Fiber Communications, 3rd ed. London, UK: Pearson.
3. J. Gowar, Optical Communication Systems, 2nd ed. New Delhi, India: Prentice-Hall of India.

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 & DEVICES															
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	-	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO4	3	2	2	2	2	-	-	-	-	-	-	-	2	2	1
Average	3.0	2.6	2.4	2.0	1.6	-	-	-	-	-	-	-	2.4	1.8	1.0
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
MICROWAVE THEORY AND TECHNIQUES	**EI3223**	**3-0-0**	**3**

Prerequisite: Basic understanding of Electromagnetic field

Course Outcomes:

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

CO1: Characterize the microwave transmission lines and components.
CO2: Design microwave circuits and networks using appropriate techniques.
CO3: Analyze the behavior of microwave circuits and devices.
CO4: Analyze microwave systems and their components.

Module I: **06 Hours**

Introduction to microwave frequencies and applications., Microwave transmission lines: waveguides and coaxial lines, Types of waveguides: rectangular, circular. Properties and characteristics of waveguides.

Module II: **09 Hours**

Microwave components: isolators, circulators, couplers, and filters.

Network Analysis: Introduction to the Smith Chart and its applications, Impedance matching techniques using the Smith Chart, Introduction to ABCD parameters and S-parameters.

Module III: **08 Hours**

Overview of microwave transistors: BJTs, FETs. Principles of operation and applications of microwave amplifiers. Introduction to microwave tubes: klystrons, TWTs.

Module IV: **07 Hours**

Passive Components: Microwave filters: types, design principles, applications. Microwave diodes and attenuators: principles of operation, applications. RF switches and phase shifters: types, principles, applications.

Antennas: Fundamentals of antennas: radiation patterns, directivity, gain.

Total lecture hours: **30 Hours**

Text Book:

1. Pozar, D. M. (2011). Microwave Engineering (4th ed.). Wiley.
2. Khan, A. S. (2019). Microwave Engineering: Concepts and Fundamentals (1st ed.). CRC Press.

Reference Book:

1. Gonzalez, G. (1996). Microwave Transistor Amplifiers: Analysis and Design (2nd ed.). Prentice Hall.
2. Rizzi, P. A. (2003). Microwave Engineering: Passive Circuits (1st ed.). Prentice Hall.

CO-PO-PSO MAPPING

MICROWAVE THEORY AND TECHNIQUES															
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	-	-	-	-	-	-	-	-	2	1	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO4	3	2	2	2	2	-	-	-	-	-	-	-	2	2	1
Average	3	2.5	2.5	1.75	1.5	-	-	-	-	-	-	-	2.5	1.75	0.75
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
MACHINE LEARNING	EI3225	3-0-0	3

Prerequisite: Data Structures, Basics of Probability and Statistics

Course Outcomes:

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

CO1: Grasp and develop algorithms for linear, logistic, and multivariate regression.

CO2: Design and implement linear and nonlinear classifiers based on SVM, Neural networks and Decision trees.

CO3: Identify and implement clustering techniques for moderate to large size data.

CO4: Evaluate and interpret the results of the machine learning algorithms.

Module I: Introduction to probability and linear algebra **04 Hours**

Review of Probability Theory and Linear algebra, Convex Optimization, relationship between AI, ML, and DL

Module II: **10 Hours**

Introduction to Statistical Decision Theory, Regression: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Logistic Regression, Partial Least Squares Classification: Linear Classification, LDA

Introduction to Perceptron and SVM, Neural Networks: Introduction, Early Models, Perceptron Learning, Back-propagation, Initialization of neural network, Training and Validation, Parameter Estimation

Module III: **10 Hours**

Introduction to Bayesian Learning, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naive Bayes classifier

Decision Trees - Stopping Criterion and Pruning, Loss function, Categorical Attributes, Multiway Splits, Missing values, Instability, Regression Trees. Bootstrapping and Cross Validation, Class Evaluation, Measures, ROC curve, MDL, Ensemble methods, Committee Machines and Stacking.

Module IV: **06 Hours**

Partitional clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density- Based Clustering, Gaussian Mixture Models, Expectation Maximization, Learning Theory, Re-enforcement Learning

Total lecture hours: **30 Hours**

Text Book:

1. Rajiv Chopra, Machine Learning, Khanna Book Publishing Company, 2023.
2. Hastie, T. R. Tibshirani, and J. G. Friedman, “The Elements of Statistical Learning: Data Mining, Inference and Prediction”, New York, NY: Springer,
3. EthemAlpaydin, “Introduction to Machine Learning”, PHI, 2005.
4. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media, 2016

Reference Book:

1. Bishop Christopher, “Neural Networks for Pattern Recognition”, New York, NY: Oxford University Press,
2. Mitchell Tom, “Machine learning”, New York, NY: McGraw-Hill,
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani “Introduction to Statistical Learning”, Springer, 2013.
4. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.

CO-PO-PSO MAPPING

MACHINE LEARNING															
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	3	2	2	2	0	0	0	0	1	0	1	3	2	0
CO2	3	2	3	2	3	0	0	0	1	1	1	2	3	3	1
CO3	2	3	2	2	2	0	0	0	1	1	0	1	3	2	0
CO4	3	3	2	3	2	0	0	0	1	2	0	2	3	3	1
Average	2.75	2.75	2.25	2.25	2.25	0	0	0	0.75	1.25	0.25	1.5	3	2.5	0.5
Level of Correlation:			3 - High			2 - Medium				1 – Low					

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
VLSI DESIGN	EI3205	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 knowledge of design methodology, design flow, design styles, scaling and submicron issues in VLSI Design.
- **CO2:** Evaluate different electrical parameters of a MOS transistor.
- **CO3:** Design different CMOS circuits and memory components using various logic families along with their layout and stick diagrams.
- **CO4:** Analyse critical voltages, switching delays, power dissipation, and timing parameters in VLSI designs.

Module I: **08 Hours**

Overview of VLSI Design: Historical perspective, overview of VLSI design methodologies, VLSI design flow, design hierarchy, concepts of regularity, modularity, and locality, VLSI design styles, design quality, packaging technology, CAD technology.

MOS Transistor Theory: Introduction to metal oxide semiconductor (MOS) structure, long channel I-V characteristics, Electrical parameters, DC transfer characteristics. Scaling and submicron issues.

Module II: **08 Hours**

MOS Inverter (Static Characteristics): Resistive-load inverter, inverter with n-type MOSFET load, CMOS inverter. Layout and stick diagrams.

MOS Inverters (Switching Characteristics and Interconnects effects): Delay-time definitions, calculation of delay times, estimation of interconnect parasitics, calculation of interconnect delay, switching power dissipation of CMOS inverters.

Module III: **08 Hours**

Combination CMOS Logic Circuits: Implementation using CMOS, CMOS transmission gates (pass gates), dynamic and domino logic circuits.

Sequential MOS logic circuits: Behaviour of bi-stable elements, SR latch circuits, clocked latch and flip-flop circuits, CMOS D-latch, and edge-triggered flip-flop.

Module IV: **06 Hours**

Timing Parameters: Timing path, Setup time and hold time static, example of setup and hold time static, setup and hold slack, clock skew and jitter, Clock, reset and power distributions.

S**emiconductor Memories:** Memory Design, SRAM, DRAM structure and implementations.

Total lecture hours: **30 Hours**

Text Book:

1. Sung Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis and Design, Mc Graw Hill, 2nd Edition.
2. Anantha P. Chandrakasan, Borivoje Nikolic, and Jan M. Rabaey, Digital Integrated Circuits: A Design Perspective, Pearson Education, 2nd Edition.

Reference Book:

1. N. H. E. Weste and C. Harris, “Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007.

CO-PO-PSO MAPPING

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 l	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															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
BUSINESS MANGEMENT	BH3401	3-0-0	2

Prerequisite:

Course Outcomes:

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

CO1: Comparing and contrasting efficient functional models of business management by integrating the three core areas such as Finance, Human Resource and Marketing Management.

CO2: Executing the Management principles in all the functional areas of business.

CO3: Correlating the interrelations and interdependence of the areas of Management in a business organisation.

CO4: Assessing the functional and managerial practices in business organisations.

Module I: Management Principles **08 Hours**

Management Concepts, Nature and Functions, Management Process and Roles of Managers, Levels of Management and Managerial Skills, Theories of Management – Contributions of F.W.Taylor, Henry Fayol, Elton Mayo, Line and Staff Relationship, Centralisation and Decentralisation, Delegation of Authority , Management thoughts in Modern Trend –Systems Approach

Module II: Financial Management **08 Hours**

Concept, Financial function and Role of Financial Managers, Instruments of raising short-term and long-term funds, Capital Structure, Techniques of Project Appraisal, Components of Working Capital, Operating Cycle, Factors affecting requirement of Working Capital.

Module III: Human Resource Management **07 Hours**

Nature and Scope of Human Resource Management, Manpower Planning, Recruitment and Selection Methods, Performance Appraisal, Need, Objectives, Modern methods of Appraisals: 720 degree, MBO, Assessment Centre Method, Talent Acquisition, Training Need Analysis, Career Planning, Organisational Citizenship Behaviour.

Module IV: Marketing Management **07 Hours**

Concept, Nature, Scope and Importance, Marketing Mix and 7P's of Marketing, Segmentation, Targeting, Positioning, Factors influencing consumer decision-making, e-marketing and Green Marketing

Total lecture hours: **30 Hours**

Text Book:

1. Modern Business Organisation and Management, S.A. Sherlekar, Himalaya Publishing House, 2016.
2. Essentials of Management, Stephen P. Robbins, 6th Edition, Pearson, 2010.
3. Financial Management, Sheeba Kapil, 1st Edition,Pearson, 2013.
4. Human Resource Management Text and Cases, K. Aswathappa, 10th Edition,TMH, 2023

Reference Book:

1. Marketing Management, Rajan Saxena, 6th Edition, TMH publishing house, 2022.
2. Principles of Management, Dipak Kumar Bhattacharyya, 1st Edition, Pearson, 2011
3. Mgmt (Principles of Management), Willium& Tripathy, 1st Edition, Cengage Learning, 2016

CO-PO-PSO MAPPING

BUSINESS MANGEMENT															
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	-	2	-	2	-	2	2	3	3	3	3	3	-	-	-
CO2	-	-	-	-	-	1	3	3	3	3	3	3	-	-	-
CO3	-	-	-	-	2	2	1	3	3	3	3	3	-	-	-
CO4	-	-	-	-	-	1	1	3	3	3	3	3	-	-	-
Average	-	0.5	-	0.5	0.5	1.5	1.75	3	3	3	3	3	-	-	-
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
ENTREPRENEURSHIP DEVELOPMENT	BH3403	3-0-0	2

Prerequisite:

Course Outcomes:

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

CO1: Exemplifying the business opportunities, social responsibilities and the support system for setting up an enterprise.

CO2: Determining stages of Entrepreneurial Process starting from idea generation, developing a business plan and operational aspects of an Enterprise.

CO3: Appraising the different funding options and Financial Management of an enterprise.

CO4: Assessing the Start-up management practices like incubation, mentorship and Government initiatives.

Module I: Introduction to Entrepreneurship **08 Hours**

Concept, Functions of an Entrepreneur, Entrepreneurial Process, Entrepreneurial Motivation and Barriers, Traits to be a successful Entrepreneur, Creativity and scope of Entrepreneurship in India: Types of new age business (FinTech, EdTech, Healthcare, Agripreneurship, Defence, Drone, Space, IT, Robotics, Digital Transformation, Women-Entrepreneurship, Social Entrepreneurship, Corporate Social Responsibility, Business Ethics – Role of Values in Management.

Module II: Entrepreneurial Idea into Action **08 Hours**

Developing a Business Idea; Opportunity, Methods and Creativity, Deciding to set up a start-up, Forms of business organisations (Sole tradership/propreitorship, Partnership, Joint-Stock Company) and MSMEs (Micro, Small and Medium enterprises), Size and Location of the enterprise, Feasibility Study: Market Survey, Techno-economic feasibility and preparing a Project Report.

Module III: Entrepreneurial Finance and Funding **07 Hours**

Sources of funding(Bootstrapping, Angel Investors, Venture Capital, Crowdfunding etc.) Project Investment Analysis, Break-Even Analysis, ROI Analysis, Basics of Income Statement and Balance Sheet.

Module IV: Managing an Enterprise **07 Hours**

The Start-up ecosystem, Business Incubators, Start-up Accelerators, Mentorship and Networking, Failure and Resilience, Risk Management, Ethical dilemmas and Exit Strategies, Start-up Policy and Initiatives of the Government.

Total lecture hours: **30 Hours**

Text Book:

1. Entrepreneurship: Successfully Launching New Ventures, B.R. Barringer, 6th, Pearson, 2020
2. Fundamentals of Entrepreneurship and Project planning, Madhurima Lall, 1st, Sultan Chand & Sons, 2021
3. Entrepreneurial Development,S.S. Khanka, 1st Edition, S Chand and Company, 1999
4. Entrepreneurship Development and Small business enterprises, P.M. Charantimath, 3rd Edition, Pearson, 2019

Reference Book:

1. Entrepreneurship: Theory, Process and Practice, Donald F Kuratco, 11th, Cengage, 2023
2. Entrepreneurship, Robert. D. Hisrich & Sabyasachi Sinha, 11th Edition, TMH, 2020

CO-PO-PSO MAPPING

ENTREPRENEURSHIP DEVELOPMENT															
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	-	-	-	-	2	3	3	3	3	3	3	3	-	-	-
CO2	-	2	2	2	2	3	3	3	3	3	3	3	-	-	-
CO3	-	-	-	-	2	3	3	3	3	3	3	3	-	-	-
CO4	-	-	-	-	2	3	3	3	3	3	3	3	-	-	-
Average	-	0.5	0.5	0.5	2	3	3	3	3	3	3	3	-	-	-
Level of Correlation: 3 - High 2 - Medium 1 – Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ENVIRONMENTAL ENGINEERING	**IP 3401**	**3-0-0**	**2**

Prerequisite: Basic Physics, Basic Chemistry

Course Outcomes:

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

CO1: Understand the multidisciplinary nature of environmental science and ecosystem structure and functions

CO2: Analyze various forms of environmental pollution and assess their impact using scientific parameters

CO3: Demonstrate knowledge of water and wastewater treatment processes and air pollution control technologies

CO4: Evaluate the role of environmental policies, EIA, and sustainable practices in pollution control and resource conservation

Module I: **10 Hours**

Fundamentals of Environment and Ecosystem: Multidisciplinary nature of environmental Engineering.

Study of Ecosystem: Definition, Properties, Structure and Function of an ecosystem. Food chains, food webs, Flow of Energy, Ecological Pyramids, Biogeochemical cycles, Types of ecosystems, Bioaccumulation, Bio magnification, ecosystem value, Degradation of Ecosystem.

Concept of Environment and pollution: Atmospheric chemistry, soil chemistry, water quality characteristics, DO, BOD and COD, water pollution, Marine Pollution, soil pollution, thermal pollution, nuclear hazard, Air Pollution: Air Quality, cause and effects of air pollution, Water and air quality standards, and Index, Noisepollution: Introduction, Noise standards, measurement, Ln Concept and control

Module II: **08 Hours**

Water treatment process: Pre-treatment of water, conventional process, advanced water treatment process.

Waste water treatment process: Natural Treatment, Engineering Treatment -Pre- treatment, primary and secondary waste water treatment process

Air Pollution Control: The natural self-cleansing properties of Environment, Air pollution meteorology, Atmospheric dispersion, Diffusion equation, ground level emission, plume rise, Effective stack height, Air Pollution control from stationarysources by installing Engineering devices, Flue gas desulphurisation, NOX removal.

Module III: **08 Hours**

Solid waste management: Source, classification, separation, storage and transportation of solid wastes, Waste minimization techniques, Benefits of waste minimization, reuse, recycle, thermal and biological treatment, secure land fill technique.

Impact of Environmental pollution and related issues: Global climate change, global warming and greenhouse gases, Acid rain, ozone layer depletion, health issues.

Module IV: **07 Hours**

Environmental Impact Assessment: EIA procedure, Preparation of an EIS From unsustainable to sustainable development, circular economy, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Preventionand Control of Pollution) Act, Wildlife Protection Act.

Total lecture hours: **30 Hours**

Text Book:

1. Fundamentals of Ecology, M.C.Dash, Tata McGraw Hill, 2006.
2. Environmental Pollution Control Engineering, C.S. Rao, New Age International Publishers, 2018
3. Environmental Engineering, G. Kiely, TMH, 2007
4.

Reference Book:

1. Environmental Engineering, H.S. Peavy, D.R. Rowe and G. Tchobanoglous, McGraw Hill.
2. Introduction to Environmental Engineering and Science, G.M. Masters, Pearson, 2015
3. Integrated Solid Waste Management, G. Tchobanoglous, McGraw Hill, 2014
4. Water Supply Engineering, S.K. Garg; Khanna Publishers, 37th Edition

CO-PO-PSO MAPPING

ENVIRONMENTAL 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	1	1	1	2	3	1	1	2	1	2	2	2	3
CO2	3	3	2	2	2	2	3	1	1	2	1	2	2	2	3
CO3	3	3	3	2	2	2	3	1	2	2	2	3	3	3	3
CO4	2	2	2	2	1	3	3	2	2	2	2	3	3	3	2
Average	2.75	2.5	2	1.75	1.5	2.25	3	1.25	1.5	2	1.5	2.5	2.5	2.5	2.75
Level of Correlation: 3 - High 2 - Medium 1 – Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
INDUSTRIAL SAFETY ENGINEERING	IP3403	3-0-0	2

Prerequisite:

Course Outcomes:

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

CO1: Apply safety principles in various work environments, especially in construction and machine operations.

CO2: Identify safety hazards, implement safety measures,

CO3: Analyse risks to prevent accidents and injuries.

CO4: Understand of safety protocols, policies, and the responsibilities of individuals and organizations in ensuring a safe working environment.

Module I: **06 Hours**

Safety Introduction: Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.

Module II: **07 Hours**

Personal Protection in work environment: Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

Module III: **07 Hours**

Safety issues in Construction: Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

Module IV: **07 Hours**

SafetyHazardsinMachines and Hazardidentificationandanalysis: Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices.Safetyinturning,andgrinding.WeldingandCutting-SafetyPrecautionsofGas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance.

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identificationofhazards:Inventoryanalysis,Fireandexplosionhazardratingofprocessplants

The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis, Hazard and Operabilitystudy(HAZOP))–methodology,criticalityanalysis,correctiveactionandfollow-up. Control of Chemical Hazards, Hazardous properties of chemicals, Material Safety Data Sheets (MSDS).

Total lecture hours: **30 Hours**

Text Book:

1. R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
2. Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication.
3. Krishnan, N.V. (1997).Safety management in Industry. Jaico Publishing House, New Delhi.

Reference Book:

1. John V. Grimaldi and Rollin H.Simonds. (1989) Safety management. All India Traveller Book Seller, Delhi.
2. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, New Delhi.
3. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
4. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai

CO-PO-PSO MAPPING

INDUSTRIAL SAFETY 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 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	-	3	-	-	-	-	3	2	3
CO2	3	3	3	2	-	-	-	3	2	-	-	-	3	2	3
CO3	3	3	3	2	-	-	-	3	-	-	-	-	3	2	3
CO4	2	2	1	2	-	3	-	3	2	2	-	-	2	2	2
Average	2.75	2.75	2.5	2	0.5	1.25	-	3	1	0.5	-	-	2.75	2	2.75
Level of Correlation: 3 - High 2 - Medium 1 – Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL COMMUNICATION LAB	EI3521	0-0-3	1.5

Prerequisite: Basic working knowledge of MATLAB, Simulink, LabVIEW.

Course Outcomes:

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

- **CO1:** Simulate and analyze various digital modulation schemes using MATLAB/Simulink/LabVIEW.
- **CO2:** Evaluate system performance in different channel environments such as AWGN and Rayleigh fading channels.
- **CO3:** Analyze, interpret BER performance of different modulation and coding techniques, implement channel coding schemes and assess their error correction capabilities.
- **CO4:** Apply digital communication concepts to real-time signal processing including audio and image transmission.

LIST OF EXPERIMENTS

(Any 10 experiments should performed and should be implemented using MATLAB/Simulink/LabVIEW)

EXP 1 : PN Sequence Verification – Check whether the given sequence is a PN sequence by verifying Balance Property, Run Length Property, and Autocorrelation Property.

EXP 2 : Modeling – Generate different mobile channels (e.g., Rayleigh, Rician) and verify their properties (impulse response, frequency response, histogram).

EXP 3 : ASK, FSK, PSK Modulation and Demodulation – Implement using Simulink.

EXP 4 : BER Analysis of BPSK – Plot BER curves in AWGN and Rayleigh channels.

EXP 5 : BER Analysis of BFSK – Plot BER in AWGN and Rayleigh channels using coherent/non-coherent detection.

EXP 6 : QPSK vs 4-QAM – Compare BER performance in AWGN and Rayleigh fading channels.

EXP 7 : BER Analysis of MSK – Analyze MSK performance in different channel conditions.

EXP 8 : Error Detection using Hamming Code – Simulate transmission with Hamming coding and evaluate BER in AWGN and Rayleigh channels.

EXP 9 : Spectral Analysis of Audio Signals – Record a real-time audio signal and analyze its spectrum.

EXP 10 : BPSK Modulation of Image Data – Transmit an image using BPSK and recover it in noisy conditions.

EXP 11 : 16-QAM Image Transmission – Use 16-QAM to transmit and receive an image under noisy channels.

EXP 12 : Eye Diagram Analysis – Generate and interpret eye diagrams for different modulation schemes.

EXP 13 : Implementation of Convolutional Coding – Encode a message and decode using Viterbi algorithm.

EXP 14 : Differential Modulation (DPSK) – Implement and evaluate DPSK under AWGN channel.

EXP 15 : MIMO Channel Simulation – Simulate a basic MIMO system and analyze its capacity.

EXP 16 : Design an OFDM transmitter and receiver using GNU radio. Implement of direction of arrival estimation using array processing.

EXP 17 : A mini-project/case study suitable for students to simulate a full digital communication system including modulation, channel effects, and decoding.

Text Book:

1. S. Haykin, *Digital Communications*, 1st ed. New York, NY, USA: Wiley, 1988.
2. J. G. Proakis and M. Salehi, *Digital Communications*, 5th ed. New York, NY, USA: McGraw-Hill, 2008.

Reference Book:

1. L. W. Couch, *Digital and Analog Communication Systems*, 8th ed. Boston, MA, USA: Pearson, 2013.
2. K. Choi and H. Liu, *Communication Systems Modeling and Simulation using MATLAB and Simulink*, Hoboken, NJ, USA: Wiley, 2013.
3. R. G. Lyons, *Understanding Digital Signal Processing*, 3rd ed. Boston, MA, USA: Pearson, 2010.

CO-PO-PSO MAPPING

DIGITAL COMMUNICATION LAB														
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	1	1	1	1	2	3	2	2
CO2	3	2	3	2	2	1	1	1	2	2	1	2	3	2	2
CO3	3	3	3	2	3	2	1	1	2	2	1	2	3	3	3
CO4	3	3	3	2	3	2	1	1	2	2	1	2	3	3	3
Average	3.0	2.5	2.8	2.0	2.5	1.5	1.0	1.0	1.8	1.8	1.0	2	3.0	2.5	2.5
Level of Correlation: 3 - High 2 - Medium 1 – Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
PULSE AND DIGITAL CIRCUITS LAB	**EI3523**	**0-0-3**	**1.5**

Prerequisite: Basic Electronics, Analog Electronic Circuits.

Course Outcomes:

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

- **CO1:** Design and implement multivibrator circuits using BJT, MOSFET, or 555 timer to generate and analyze various pulse waveforms.
- **CO2:** Construct and analyze clipping, clamping, comparator, and Schmitt trigger circuits using Op-Amps to understand non-linear signal shaping.
- **CO3:** Build and simulate advanced waveform generation circuits including VCOs, PLLs, PWM, and ramp generators using Op-Amps and ICs.
- **CO4:** Demonstrate the use of analog simulation tools (LTSpice/MATLAB) and digital measurement equipment (DSO, virtual instrumentation) for circuit analysis.

LIST OF EXPERIMENTS
(Any 10 experiments should be performed)

EXP 1 : Design of Bistable Multivibrator using BJT / MOSFET / 555 Timer – Observe waveform and switching behavior.

EXP 2 : Design of Monostable Multivibrator using BJT / MOSFET / 555 Timer – Determine time delay and stability.

EXP 3 : Design of Astable Multivibrator using BJT / MOSFET / 555 Timer – Measure frequency and waveform characteristics.

EXP 4 : Clipping and Clamping Circuits – Study behavior under sinusoidal and square wave inputs.

EXP 5 : Op-Amp Applications (OP-27) – Perform mathematical operations and design comparator and Schmitt trigger circuits.

EXP 6 : Voltage-Controlled Oscillator (VCO) – Implement using Op-Amp and analyze frequency variation.

EXP 7 : Charge Amplifier – Design and analyze using Op-Amp; understand its use in sensor interfacing.

EXP 8 : Clock Pulse Generator – Design and test using analog or digital circuits.

EXP 9 : Instrumentation Amplifier – Design using Op-Amps and analyze gain as a function of resistance.

EXP 10 : Phase-Locked Loop (PLL) – Implement and study its applications in frequency synthesis and clock recovery.

EXP 11 : Schmitt Trigger using NE555 Timer – Analyze hysteresis characteristics and threshold voltages.

EXP 12 : Time Base Generator – Design ramp and sawtooth waveform generators using analog circuits.

EXP 13 : Sigma-Delta ADC – Simulate using LTSpice or MATLAB; analyze resolution and quantization noise.

EXP 14 : Waveform Generator using Op-Amps – Design circuits to generate triangular, square, and sine waves.

EXP 15 : Pulse Width Modulation (PWM) Generator – Implement using NE555 Timer or Op-Amp.

EXP 16 : Frequency response measurement using virtual instrumentation or DSO.

Text Book:

1. Anand Kumar, *Pulse and Digital Circuits*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2010.
2. A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 7th ed. New York, NY, USA: Oxford Univ. Press, 2015.

Reference Book:

1. J. Millman and H. Taub, *Pulse, Digital and Switching Waveforms*, New York, NY, USA: McGraw-Hill, 1991.
2. R. L. Boylestad, *Electronic Devices and Circuit Theory*, 11th ed. Upper Saddle River, NJ, USA: Pearson, 2013.
3. B. Razavi, *Fundamentals of Microelectronics*, 2nd ed. Hoboken, NJ, USA: Wiley, 2013.

CO-PO-PSO MAPPING

PULSE AND DIGITAL CIRCUITS LAB															
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	0	0	0	0	0	1	0	1	3	2	0
CO2	3	2	3	2	0	0	0	0	0	1	0	1	3	1	0
CO3	3	2	3	2	2	0	0	0	0	0	0	2	3	3	0
CO4	3	2	0	2	3	0	0	0	0	1	0	3	2	3	0
Average	3	2	2.25	2	1.25	0	0	0	0	0.75	0	1.75	2.75	2.25	0
Level of Correlation: 3 - High 2 - Medium 1 - Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
DIGITAL SIGNAL PROCESSING LAB	**EI3525**	**0-0-3**	**1.5**

Prerequisite: Signals and Systems

Course Outcomes:

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

- **CO1:** Simulate and manipulate basic signals using MATLAB for various DSP applications.
- **CO2:** Compute and analyse linear, circular convolution, correlation of discrete-time signals and solve difference equations.
- **CO3:** Perform DFT and FFT analysis, and interpret magnitude and phase spectra.
- **CO4:** Design and implement FIR and IIR digital filters to meet given specifications.

LIST OF EXPERIMENTS

(Any 10 experiments should be performed)

EXP 1 : Simulation of basic signals (unit step, impulse, ramp, exponential, sine, cosine) using MATLAB.

EXP 2 : Linear convolution of two sequences – Verify commutative, distributive, and associative properties.

EXP 3 : Auto-correlation and cross-correlation of two sequences – Verify symmetry and linearity properties.

EXP 4 : Solve a given difference equation using MATLAB – Analyze system response.

EXP 5 : Compute N-point DFT of a sequence and plot magnitude and phase spectra – Verify using built-in function.

EXP 6 : Perform circular convolution of two sequences using MATLAB.

EXP 7 : Linear convolution using Overlap-Add and Overlap-Save methods for long duration signals.

EXP 8 : FFT computation using DIT-FFT and DIF-FFT algorithms – Analyze and compare performance.

EXP 9 : Design and implementation of FIR filters using window methods – Plot frequency response.

EXP 10 : Design and implementation of IIR filters using Butterworth and Chebyshev methods.

EXP 11 : Perform spectral analysis of a real-time signal using FFT.

EXP 12 : Reconstruct signals using inverse DFT – Analyze effects of zero-padding and spectral leakage.

EXP 13 : Analyze quantization effects and round-off errors in digital signal processing.

EXP 14 : Z-transform and inverse Z-transform – Simulation and verification using MATLAB.

EXP 15 : Apply digital FIR/IIR filters to an audio signal and observe time-frequency characteristics.

EXP 16 : Mini-projects: Audio equalizer design, ECG signal filtering, noise removal, etc.

Text Book:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2006.
2. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th ed. New York, NY, USA: McGraw-Hill, 2011.

Reference Book:

1. A. V. Oppenheim and R. W. Schafer, *Discrete-Time Signal Processing*, 3rd ed. Upper Saddle River, NJ, USA: Pearson, 2010.
2. R. G. Lyons, *Understanding Digital Signal Processing*, 3rd ed. Upper Saddle River, NJ, USA: Pearson, 2010.
3. M. H. Hayes, Digital Signal Processing, New York, NY, USA: Schaum's Outline Series, McGraw-Hill, 1998.

CO-PO-PSO MAPPING

DIGITAL SIGNAL PROCESSING LAB															
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	-	-	-	-	-	-	-	3	2	2
CO2	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
Average	3	2.7	2.5	2.5	2.2	-	-	-	-	-	-	1.3	3	2.7	2.2
Level of Correlation: 3 - High 2 - Medium 1 - Low															

SIXTH SEMESTER

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
MICROPROCESSOR & MICROCONTROLLERS	EI3103	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: Apply knowledge of internal architecture of microprocessors and microcontrollers to analyze its operation.

CO2: Analyze the various addressing modes, instruction sets and timing diagrams of microprocessor and microcontrollers.

CO3: Evaluate appropriate assembly language programs, and concept of interrupts and stacks to provide solutions real-world control problems.

CO4: Apply the concept of Address maps for Memory and I/O interfacing for different applications using 8255 PPI.

Module I: **8 Hours**

Introduction to Microprocessors (8085/8086) - Architecture, Register Organization, Signal descriptions, timing diagrams, Stacks and Subroutines, Interrupts.

Module II: **9 Hours**

Interfacing with microprocessors (8085/ 8086)- Addressing modes, Instruction sets, Assembly language programing, Address maps, Memory and I/O interfacing, Interfacing using 8255 PPI.

Module III: **8 Hours**

Introduction to microcontrollers 8051- Basic features, register organization, Addressing Modes, Instructions, Assembly language programing, Interfacing.

Module IV: **5 Hours**

Introduction to RISC- Features of ARM Processor, Instruction set, assembly language programming.

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.
3. The 8051Microcontroller and Embedded Systems: Using Assembly and C. Front Cover. Muhammad Ali Mazidi, Janice GillispieMazidi, Pearson/Prentice Hall, 2006.
4. Steve Furber, Arm System-On-Chip Architecture, 2/E, Pearson Education, 2009.

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.
4. Jonathan W. Valvano, *Embedded Microcomputer Systems: Real Time Interfacing*, 3rd Edition, Cengage Learning, 2011

CO-PO-PSO MAPPING

MICROPROCESSOR & MICROCONTROLLERS															
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	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	3	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	2.8	3.0	3.0	1.5	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															

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Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
CONTROL SYSTEM ENGINEERING	EI3105	3-0-0	3

Prerequisite: Basic Electrical Engineering, Circuit Theory, Laplace Transform, and Second-Order Differential Equations

Course Outcomes:

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

CO1: Explain fundamental control system concepts and develop mathematical models of mechanical, electrical, and electromechanical systems.

CO2: Analyze and represent control systems using block diagrams and signal flow graphs, and assess the impact of feedback on system behavior.

CO3: Evaluate time-domain responses of control systems and determine stability using classical methods such as Routh-Hurwitz and root locus.

CO4: Analyze frequency response characteristics and assess system performance and stability using Bode plots, Nyquist criterion.

Module I: Introduction to Control Systems and System Modeling **10 Hours**

An Example of Control Action, Open-Loop Control System, Closed-Loop Control System, Mathematical Modelling of different system: rotational systems and their electrical analogy, mechanical coupling, servo motors, stepper motor, Application of Laplace Transform in Control Systems, Laplace Transform, Derivation, Basic Theorems. Poles and Zeros of Transfer Function, Transfer Function and Impulse Response Relationship, Procedure for Determining Transfer Function of physical systems. Rules for Drawing Signal Flow Graphs, Mason's Gain Formula, Converting Block Diagrams to Signal Flow Graphs.

Module II: Feedback characteristics of Control Systems **6 Hours**

Feedback and non-feedback systems, Reduction of parameter variations, Control over system dynamics, Effect of feedback on disturbance rejection, System sensitivity to parameter variations and external disturbances.

Module III: Time Domain Analysis **10 Hours**

Different response functions (impulse, step, ramp, etc.), First order systems, second order systems, higher order systems, typical test signals, transient analysis of second order systems, overshoot, damping, settling time and rise time, Analysis of multi-order control system with dominant poles, steady state error analysis, error coefficients, generalised error series, transient analysis with derivative control, integral control and proportional control, rate feedback control, Routh Hurwitz stability criteria, static and dynamic error coefficients, Introduction to system optimization.

Module IV: Stability & Frequency Domain Analysis **6 Hours**

Root locus plots, Bode plots (logarithmic, magnitude-phase), Polar plot, Nyquist criterion, Gain and phase margins, Closed-loop frequency response

Total lecture hours: **32 Hours**

Text Book:

1. K. Ogata, Modern Control Engineering, PHI.
2. Gene Franklin, J. D. Powell, and Abbas Emami-Naeini, Feedback Control of Dynamic Systems, Prentice Hall.
3. Norman S. Nise, *Control Systems Engineering*, 7th Edition, Wiley.

Reference Book:

1. B. Kuo, Control System Engineering, PHI.
2. Eronini I. Umez-Eronini, System Dynamics and Control, Thomson Engineering.
3. Richard C. Dorf, *Modern Control Systems*, Pearson.

CO-PO-PSO MAPPING

CONTROL 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	2	1	1	0	0	0	0	0	0	0	2	2	0
CO2	2	3	3	2	1	0	0	0	0	0	0	0	3	2	0
CO3	3	3	3	2	2	0	0	0	0	0	0	0	3	3	0
CO4	2	3	3	3	2	0	0	0	0	0	0	0	2	3	0
Average	2.5	2.75	2.75	2.0	1.5	0	0	0	0	0	0	0	2.5	2.5	0
Level of Correlation:			3 - High			2 - Medium			1 – Low						

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
COMPUTER NETWORKS	EI3204	3-0-0	3

Prerequisite: Discrete Mathematics, Basics of Data Communication

Course Outcomes:

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

CO1: Comprehend the concepts of data communication network types and protocol and OSI model.
CO2: Illustrate the Data link layer and MAC layer of OSI architecture.
CO3: Identify the protocols and services of wired and wireless LAN.
CO4: Recognize the routing and switching of Network layers and Internet Protocol.

Module I: **6 Hours**

Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet.

Network Models: Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.

Module II: **8 Hours**

Data-link Layer: Nodes and Links, Services, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking.

Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/ CA

Module III: **8 Hours**

Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control.

Module IV: **8 Hours**

Network Layer: Network Layer Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution, Forwarding of IP Packets: Based on destination Address and Label.

Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams.

Total lecture hours: **30 Hours**

Text Book:

1. Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.
2. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education.

Reference Book:

1. James J Kurose, Keith W Ross, "Computer Networks", Pearson Education.
2. Andrew S Tanenbaum, "Computer Networks", Prentice Hall.
3. William Stallings, "Data and Computer Communications", Prentice Hall.

CO-PO-PSO MAPPING

COMPUTER NETWORKS															
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	1	1	-	-	-	-	1	-	1	3	1	-
CO2	3	3	2	2	2	-	-	-	-	1	-	1	3	2	-
CO3	3	3	2	2	2	-	-	-	1	1	-	2	3	3	2
CO4	3	3	3	2	3	-	-	-	1	1	-	2	3	3	2
Average	3	2.75	2	1.75	2	0	0	0	1	1	0	1.5	3	2.25	1
Level of Correlation:			3 - High			2 - Medium				1 - Low					

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ANTENNAS AND PROPAGATION	EI3222	3-0-0	3

Prerequisite: Electromagnetic Field Theory.

Course Outcomes:

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

CO1: Identify basic antenna parameters and contrast radiation patterns of different antennas.

CO2: Design and analyze antenna arrays and wire antennas

CO3: Design and analyze aperture antennas and patch antennas

CO4: Appropriate identification of an antenna for a specific application.

Module I: **8 Hours**

Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Module II: **10 Hours**

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite lengthdipole, half wave dipole, Ground effects.

Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.

Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Module III: **7 Hours**

Microstrip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis,
Rectangular Patch, Circular Patch.

Broadband Antennas: Broadband concept, Log-periodic antennas, frequency independent antennas, Yagi-uda antennas

Module IV: **5 Hours**

Aperture Antennas:Huygen's Field Equivalence principle, radiation equations,Rectangular Aperture, Circular Aperture.

Antennas for Terrestrial mobile communication - mobile handsets and base station. Antennas for Satellite Communication, Radar systems, RFID. Ultra-wideband antenna, Wearable antenna, MEMS antenna, MIMO antenna

Total lecture hours: **30 Hours**

Text Book:

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.

Reference Book:

1. Warren L. Stutzman and Gary A. Thiele, Antenna theory and Design, 2013, 3rd edition, Wiley & Sons, New York, USA.
2. Albert Sabban, Wideband RF Technologies and Antennas in Microwave Frequencies, 2016, Wiley, New York USA.

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

CO-PO-PSO MAPPING

ANTENNAS AND PROPAGATION															
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	-	-	-	-	2	1	1
CO2	3	3	3	2	2	1	1	1	-	-	-	-	2	1	1
CO3	3	3	3	2	2	2	1	1	-	-	-	-	2	1	1
CO4	3	3	3	3	3	2	1	1	-	-	-	-	3	2	1
Average	3	2.75	2.75	2	2	1.5	1	1					2.25	1.25	1
Level of Correlation:						3 - High			2 - Medium				1 - Low		

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
WIRELESS SENSOR NETWORKS	**EI3224**	**3-0-0**	**3**

Prerequisite: Various network topology, different types of sensors, Real-time application of wireless sensor network.

Course Outcomes:

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

CO1: Evaluate the type of sensor nodes required in a particular application.

CO2: Apply the various network deployment techniques while designing a sensor network large amount of sensor nodes.

CO3: Select the parameters required for designing an energy-efficient sensor network keeping in-eye the effective time-synchronization.

CO4: Apply various concepts for assignment of MAC addresses.

Module I: **6 Hours**

Sensor Network Concept: Introduction, networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, and Mobile deployment.

Module II: **9 Hours**

Localization and Tracking: Issues and approaches, Coarse-grained and Fine-grained node localization. Problem formulations: Sensing model, collaborative localization.

Tracking multiple objects: State space decomposition. Synchronization: Issues and Traditional approaches.

Module III: **11 Hours**

Communication Protocols for Senor Networks: Application layer protocols for WSN, Transport Layer, Network Layer, Data Link Layer, and Physical Layer, Time synchronization.

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques.

Module IV: **4 Hours**

Energy-efficient and robust routing: Overview, Lifetime-maximizing energy-aware routing techniques, Geographic routing.

Total lecture hours: **30 Hours**

Text Book:

1. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press.
2. Wireless Sensor Networks: From Theory to Applications, Ibrahiem M. M. El Emary, S. Ramakrishnan, CRC Press, 1st edition, 2014.
3. Wireless Sensor Networks: Principles, Design and Applications, Shuang-Hua Yang, Springer.

Reference Book:

1. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, Taieb Znati, Springer.
2. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas, Morgan Kaufmann Series in Networking, 2004.
3. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley Inter Science.

CO-PO-PSO MAPPING

WIRELESS SENSOR NETWORKS															
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	1	1	-	-	-	-	3	2	1
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	2.25	1.5	1.25	-	-	-	-	3.0	2.5	1.5
Level of Correlation:			3 - High			2 - Medium				1 - Low					

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
EMBEDDED SYSTEMS	EI3216	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: Analyze 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: Apply knowledge of microprocessors and microcontrollers to design of embedded systems.

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	3	3	2	2	2	1	1	1	1	-	1	3	3	3
CO2	3	3	3	2	2	3	2	1	1	1	-	1	3	3	3
CO3	3	3	3	2	2	3	2	1	1	1	-	1	3	3	3
CO4	3	3	3	2	3	3	3	2	2	1	-	1	3	3	3
Average	3	3	3	2	2.25	2.75	2	1.25	1.25	1	0	1	3	3	3
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
DIGITAL IMAGE PROCESSING	**EI3226**	**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: Explain 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 TwoVariables, 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 WileyPublishers
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	3	3	3	3	3	-	-	-	-	3	3	3
Average	3	2.7	2.7	2	2	2	2	2	-	-	-	-	3	2.7	2
Level of Correlation:			3 - High			2 - Medium				1 - Low					

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
RADAR AND SATELLITE COMMUNICATION	**EI3228**	**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: Illustrate and analyze the fundamental principles and operation of various radar systems including radar equation and signal processing.

CO2: Design and 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 and design 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 l	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
CLOUD COMPUTING	**EI3220**	**3-0-0**	**3**

Prerequisite: Computer Networks.

Course Outcomes:

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

CO1: Explain the core concepts, technologies, benefits, and limitations of cloud computing, along with its modern applications.

CO2: Describe the architecture and infrastructure of cloud computing, including service (SPI) and deployment models.

CO3: Analyze critical cloud computing challenges such as security, privacy, and interoperability.

CO4: Evaluate and recommend cloud-based solutions for various real-world applications through problem analysis and decision-making.

Module I: Fundamentals of Cloud Computing **8 Hours**

Cloud Computing fundamentals: Essential characteristics, Architectural Influences, Technological Influences, and Operational Influences.

Module II: The Concepts of Virtualization and the Cloud delivery and Deployment Models **8 Hours**

Cloud Computing Architecture: Cloud Delivery models, The SPI Framework, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS),
Cloud deployment models, Public Clouds, CommMODULEy Clouds, Hybrid Clouds, Alternative Deployment models, Expected benefits.

Module III: Cloud computing software security objectives, design principles and development practices **8 Hours**

Cloud Computing Software Security fundamentals: Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.

Module IV: Cloud computing risks, challenges and threats to infrastructure, data and access control **6 Hours**

Cloud Computing Risk Issues: The CIA Traid, Privacy and Compliance Risks, Threats to Infrastructure, Data and Access Control, Cloud Access Control Issues, Cloud Service rovider Risks.
Cloud Computing Security challenges: Security Policy Implementation, Policy Types, and Computer Security Incident Response Team (CSIRT).

Total lecture hours: **30 Hours**

Text Book:

1. Ronald L. Krutz, Russell Dean Vines, *"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"*, Wiley.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *"Mastering Cloud Computing: Foundations and Applications Programming"*, McGraw Hill.
3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, *"Cloud Computing: A Practical Approach"*, McGraw Hill.
4. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, *"Distributed and Cloud Computing: From Parallel Processing to the Internet of Things"*, Morgan Kaufmann.

Reference Book:

1. John W. Rittinghouse, James F. Ransome, *"Cloud Computing: Implementation, Management, and Security"*, CRC Press.
2. Borko Furht, Armando Escalante, *"Handbook of Cloud Computing"*, Springer.
3. Charles Babcock, *"Cloud Revolution: The Coming Change in Computing"*, McGraw Hill.
4. Tim Mather, Subra Kumaraswamy, Shahed Latif, *"Cloud Security and Privacy"*, O'Reilly Media.

CO-PO-PSO MAPPING

CLOUD 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 l	PSO 2	PSO 3
CO1	3	2	2	1	1	1	1	1	1	1	1	1	2	1	1
CO2	3	3	2	2	2	1	1	1	1	1	1	1	3	2	1
CO3	3	3	3	2	2	2	2	1	1	2	2	2	3	2	1
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	1
Average	3.0	2.75	2.25	2.0	1.75	1.5	1.25	0.5	0.5	1.5	0.25	1.5	2.75	2.0	0.75
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
INTRODUCTION TO MEMS	**EI3232**	**3-0-0**	**3**

Prerequisite: NIL

Course Outcomes:

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

CO1: Apply the fundamental knowledge of MEMS principles, including microscale mechanics and forces to simple MEMS designs.

CO2: Apply MEMS fabrication processes to design and develop simple MEMS devices.

CO3: Illustrate and analyze microsystems design using finite element analysis (FEA) methods.

CO4: Analyze the working principles of micro-sensors and micro-actuators, including electrostatic, thermal, magnetic, polymer, and optical MEMS.

Module I: **8 Hours**

Introduction of MEMS- Miniaturization, Microelectronics Integration, Mass Fabrication with Precision, Microelectronics Fabrication Process, Silicon based MEMS processes, Electrostatic Sensing and Actuation: Introduction to Electrostatic Sensors and Actuators, Magnetic Actuation.

Module II: **8 Hours**

Piezoresistive Sensors: Piezoresistive Sensor Materials, Applications of Piezoresistive Sensors. Piezoelectric Sensing and Actuation: Introduction, Properties of Piezoelectric Materials, Applications. Bulk Micromachining and Silicon Anisotropic Etching: Introduction, Anisotropic Wet Etching, Dry Etching of Silicon-Plasma Etching, Deep Reactive Ion Etching (DRIE).

Module III: **7 Hours**

Polymer MEMS: Introduction, Polymers in MEMS-Polyimide, SU-8, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbo, Representative Applications-Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors.

Module IV: **7 Hours**

Optical MEMS: Passive MEMS Optical Components-Lenses, Mirrors, Actuators for Active Optical MEMS Actuators for Small Out-of-Plane Translation, Actuators for Large InPlane Translation Motion, Actuators for Out-of-Plane Rotation.

Total lecture hours: **30 Hours**

Text Book:

1. Microelectromechanical Systems by Nitaigour Mahalik .
2. Tai-ran Hsu, MEMS and microsystems design and manufacture, Nanoscale Engineering, TMGH, 2008 **.**
3. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012.
4. Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures, CRC, 2002.

Reference Book:

1. Stephen D Senturia, Microsystem Design, Springer Publication, 2000.
2. P.Seshu, Text Book of Finite Element Analysis, PHI,2006.
3. Designing CMOS MEMS by Lisa Su and Marija Vasilevska.
4. Introduction to Microelectromechanical Systems Engineering by Nadim Maluf and Kirt Williams.

CO-PO-PSO MAPPING

INTRODUCTION TO MEMS															
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	1	1	-	-	-	2	2	1	-	3	2	1
CO2	3	2	2	1	2	-	-	-	2	2	1	-	3	2	-
CO3	3	3	2	2	-	-	-	-	1	1	-	1	3	2	2
CO4	3	3	2	2	-	-	-	-	1	1	-	1	3	2	2
Average	3.0	2.5	1.75	1.5	1.0	-	-	-	1.5	1.5	0.5	0.5	3.0	2.0	1.25
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
BUSINESS MANGEMENT	BH3401	3-0-0	2

Prerequisite:

Course Outcomes:

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

CO1: Comparing and contrasting efficient functional models of business management by integrating the three core areas such as Finance, Human Resource and Marketing Management.

CO2: Executing the Management principles in all the functional areas of business.

CO3: Correlating the interrelations and interdependence of the areas of Management in a business organisation.

CO4: Assessing the functional and managerial practices in business organisations.

Module I: Management Principles **08 Hours**

Management Concepts, Nature and Functions, Management Process and Roles of Managers, Levels of Management and Managerial Skills, Theories of Management – Contributions of F.W.Taylor, Henry Fayol, Elton Mayo, Line and Staff Relationship, Centralisation and Decentralisation, Delegation of Authority , Management thoughts in Modern Trend –Systems Approach

Module II: Financial Management **08 Hours**

Concept, Financial function and Role of Financial Managers, Instruments of raising short-term and long-term funds, Capital Structure, Techniques of Project Appraisal, Components of Working Capital, Operating Cycle, Factors affecting requirement of Working Capital.

Module III: Human Resource Management **07 Hours**

Nature and Scope of Human Resource Management, Manpower Planning, Recruitment and Selection Methods, Performance Appraisal, Need, Objectives, Modern methods of Appraisals: 720 degree, MBO, Assessment Centre Method, Talent Acquisition, Training Need Analysis, Career Planning, Organisational Citizenship Behaviour.

Module IV: Marketing Management **07 Hours**

Concept, Nature, Scope and Importance, Marketing Mix and 7P's of Marketing, Segmentation, Targeting, Positioning, Factors influencing consumer decision-making, e-marketing and Green Marketing

Total lecture hours: **30 Hours**

Text Book:

1. Modern Business Organisation and Management, S.A. Sherlekar, Himalaya Publishing House, 2016.
2. Essentials of Management, Stephen P. Robbins, 6th Edition, Pearson, 2010.
3. Financial Management, Sheeba Kapil, 1st Edition,Pearson, 2013.
4. Human Resource Management Text and Cases, K. Aswathappa, 10th Edition,TMH, 2023

Reference Book:

1. Marketing Management, Rajan Saxena, 6th Edition, TMH publishing house, 2022.
2. Principles of Management, Dipak Kumar Bhattacharyya, 1st Edition, Pearson, 2011
3. Mgmt (Principles of Management), Willium& Tripathy, 1st Edition, Cengage Learning, 2016

CO-PO-PSO MAPPING

BUSINESS MANGEMENT															
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	-	2	-	2	-	2	2	3	3	3	3	3	-	-	-
CO2	-	-	-	-	-	1	3	3	3	3	3	3	-	-	-
CO3	-	-	-	-	2	2	1	3	3	3	3	3	-	-	-
CO4	-	-	-	-	-	1	1	3	3	3	3	3	-	-	-
Average	-	0.5	-	0.5	0.5	1.5	1.75	3	3	3	3	3	-	-	-
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
ENTREPRENEURSHIP DEVELOPMENT	BH3403	3-0-0	2

Prerequisite:

Course Outcomes:

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

CO1: Exemplifying the business opportunities, social responsibilities and the support system for setting up an enterprise.

CO2: Determining stages of Entrepreneurial Process starting from idea generation, developing a business plan and operational aspects of an Enterprise.

CO3: Appraising the different funding options and Financial Management of an enterprise.

CO4: Assessing the Start-up management practices like incubation, mentorship and Government initiatives.

Module I: Introduction to Entrepreneurship **08 Hours**

Concept, Functions of an Entrepreneur, Entrepreneurial Process, Entrepreneurial Motivation and Barriers, Traits to be a successful Entrepreneur, Creativity and scope of Entrepreneurship in India: Types of new age business (FinTech, EdTech, Healthcare, Agripreneurship, Defence, Drone, Space, IT, Robotics, Digital Transformation, Women-Entrepreneurship, Social Entrepreneurship, Corporate Social Responsibility, Business Ethics – Role of Values in Management.

Module II: Entrepreneurial Idea into Action **08 Hours**

Developing a Business Idea; Opportunity, Methods and Creativity, Deciding to set up a start-up, Forms of business organisations (Sole tradership/propreitorship, Partnership, Joint-Stock Company) and MSMEs (Micro, Small and Medium enterprises), Size and Location of the enterprise, Feasibility Study: Market Survey, Techno-economic feasibility and preparing a Project Report.

Module III: Entrepreneurial Finance and Funding **07 Hours**

Sources of funding(Bootstrapping, Angel Investors, Venture Capital, Crowdfunding etc.) Project Investment Analysis, Break-Even Analysis, ROI Analysis, Basics of Income Statement and Balance Sheet.

Module IV: Managing an Enterprise **07 Hours**

The Start-up ecosystem, Business Incubators, Start-up Accelerators, Mentorship and Networking, Failure and Resilience, Risk Management, Ethical dilemmas and Exit Strategies, Start-up Policy and Initiatives of the Government.

Total lecture hours: **30 Hours**

Text Book:

1. Entrepreneurship: Successfully Launching New Ventures, B.R. Barringer, 6th, Pearson, 2020
2. Fundamentals of Entrepreneurship and Project planning, Madhurima Lall, 1st, Sultan Chand & Sons, 2021
3. Entrepreneurial Development,S.S. Khanka, 1st Edition, S Chand and Company, 1999
4. Entrepreneurship Development and Small business enterprises, P.M. Charantimath, 3rd Edition, Pearson, 2019

Reference Book:

1. Entrepreneurship: Theory, Process and Practice, Donald F Kuratco, 11th, Cengage, 2023
2. Entrepreneurship, Robert. D. Hisrich & Sabyasachi Sinha, 11th Edition, TMH, 2020

CO-PO-PSO MAPPING

ENTREPRENEURSHIP DEVELOPMENT															
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	-	-	-	-	2	3	3	3	3	3	3	3	-	-	-
CO2	-	2	2	2	2	3	3	3	3	3	3	3	-	-	-
CO3	-	-	-	-	2	3	3	3	3	3	3	3	-	-	-
CO4	-	-	-	-	2	3	3	3	3	3	3	3	-	-	-
Average	-	0.5	0.5	0.5	2	3	3	3	3	3	3	3	-	-	-
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
ENVIRONMENTAL ENGINEERING	**IP 3401**	**3-0-0**	**2**

Prerequisite: Basic Physics, Basic Chemistry

Course Outcomes:

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

CO1: Understand the multidisciplinary nature of environmental science and ecosystem structure and functions

CO2: Analyze various forms of environmental pollution and assess their impact using scientific parameters

CO3: Demonstrate knowledge of water and wastewater treatment processes and air pollution control technologies

CO4: Evaluate the role of environmental policies, EIA, and sustainable practices in pollution control and resource conservation

Module I: **10 Hours**

Fundamentals of Environment and Ecosystem: Multidisciplinary nature of environmental Engineering.

Study of Ecosystem: Definition, Properties, Structure and Function of an ecosystem. Food chains, food webs, Flow of Energy, Ecological Pyramids, Biogeochemical cycles, Types of ecosystems, Bioaccumulation, Bio magnification, ecosystem value, Degradation of Ecosystem.

Concept of Environment and pollution: Atmospheric chemistry, soil chemistry, water quality characteristics, DO, BOD and COD, water pollution, Marine Pollution, soil pollution, thermal pollution, nuclear hazard, Air Pollution: Air Quality, cause and effects of air pollution, Water and air quality standards, and Index, Noisepollution: Introduction, Noise standards, measurement, Ln Concept and control

Module II: **08 Hours**

Water treatment process: Pre-treatment of water, conventional process, advanced water treatment process.

Waste water treatment process: Natural Treatment, Engineering Treatment -Pre- treatment, primary and secondary waste water treatment process

Air Pollution Control: The natural self-cleansing properties of Environment, Air pollution meteorology, Atmospheric dispersion, Diffusion equation, ground level emission, plume rise, Effective stack height, Air Pollution control from stationarysources by installing Engineering devices, Flue gas desulphurisation, NOX removal.

Module III: **08 Hours**

Solid waste management: Source, classification, separation, storage and transportation of solid wastes, Waste minimization techniques, Benefits of waste minimization, reuse, recycle, thermal and biological treatment, secure land fill technique.

Impact of Environmental pollution and related issues: Global climate change, global warming and greenhouse gases, Acid rain, ozone layer depletion, health issues.

Module IV: **07 Hours**

Environmental Impact Assessment: EIA procedure, Preparation of an EIS From unsustainable to sustainable development, circular economy, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Preventionand Control of Pollution) Act, Wildlife Protection Act.

Total lecture hours: **30 Hours**

Text Book:

1. Fundamentals of Ecology, M.C.Dash, Tata McGraw Hill, 2006.
2. Environmental Pollution Control Engineering, C.S. Rao, New Age International Publishers, 2018
3. Environmental Engineering, G. Kiely, TMH, 2007
4.

Reference Book:

1. Environmental Engineering, H.S. Peavy, D.R. Rowe and G. Tchobanoglous, McGraw Hill.
2. Introduction to Environmental Engineering and Science, G.M. Masters, Pearson, 2015
3. Integrated Solid Waste Management, G. Tchobanoglous, McGraw Hill, 2014
4. Water Supply Engineering, S.K. Garg; Khanna Publishers, 37th Edition

CO-PO-PSO MAPPING

ENVIRONMENTAL 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	1	1	1	2	3	1	1	2	1	2	2	2	3
CO2	3	3	2	2	2	2	3	1	1	2	1	2	2	2	3
CO3	3	3	3	2	2	2	3	1	2	2	2	3	3	3	3
CO4	2	2	2	2	1	3	3	2	2	2	2	3	3	3	2
Average	2.75	2.5	2	1.75	1.5	2.25	3	1.25	1.5	2	1.5	2.5	2.5	2.5	2.75
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
INDUSTRIAL SAFETY ENGINEERING	IP3403	3-0-0	2

Prerequisite:

Course Outcomes:

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

CO1: Apply safety principles in various work environments, especially in construction and machine operations.

CO2: Identify safety hazards, implement safety measures,

CO3: Analyse risks to prevent accidents and injuries.

CO4: Understand of safety protocols, policies, and the responsibilities of individuals and organizations in ensuring a safe working environment.

Module I: **06 Hours**

Safety Introduction: Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.

Module II: **07 Hours**

Personal Protection in work environment: Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

Module III: **07 Hours**

Safety issues in Construction: Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

Module IV: **07 Hours**

SafetyHazardsinMachines and Hazardidentificationandanalysis: Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices.Safetyinturning,andgrinding.WeldingandCutting-SafetyPrecautionsofGas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance.

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identificationofhazards:Inventoryanalysis,Fireandexplosionhazardratingofprocessplants

The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis, Hazard and Operabilitystudy(HAZOP))–methodology,criticalityanalysis,correctiveactionandfollow-up. Control of Chemical Hazards, Hazardous properties of chemicals, Material Safety Data Sheets (MSDS).

Total lecture hours: **30 Hours**

Text Book:

1. R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
2. Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication.
3. Krishnan, N.V. (1997).Safety management in Industry. Jaico Publishing House, New Delhi.

Reference Book:

1. John V. Grimaldi and Rollin H.Simonds. (1989) Safety management. All India Traveller Book Seller, Delhi.
2. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, New Delhi.
3. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
4. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai

CO-PO-PSO MAPPING

INDUSTRIAL SAFETY 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 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	-	3	-	-	-	-	3	2	3
CO2	3	3	3	2	-	-	-	3	2	-	-	-	3	2	3
CO3	3	3	3	2	-	-	-	3	-	-	-	-	3	2	3
CO4	2	2	1	2	-	3	-	3	2	2	-	-	2	2	2
Average	2.75	2.75	2.5	2	0.5	1.25	-	3	1	0.5	-	-	2.75	2	2.75
Level of Correlation: 3 - High 2 - Medium 1 – Low															

CO-PO-PSO MAPPING

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
MICROPROCESSOR & MICROCONTROLLERS LAB	EI3503	0-0-3	1.5

Prerequisite: Digital Electronics, Basic Programming Skills

Course Outcomes:

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

CO1: Execute assembly language programs for 8085, 8086, and 8051.

CO2: Interface microprocessors/microcontrollers with peripherals such as LEDs, stepper motors, ADC/DAC, and traffic control modules.

CO3: Simulate and implement simple microcontroller-based designs using Keil, Proteus, or equivalent.

CO4: Design simple systems using Advanced processors.

List of Experiments: (At least 10 experiments excluding Mini project should be done)

EXP 1 : Write an assembly language program to perform arithmetic and logical operations using 8085/8086/8051.

EXP 2 : Write an assembly language program to calculate the sum of a finite series of numbers.

EXP 3 : Write an assembly language program to find the largest and smallest numbers from: (a) two given numbers (b) a set of N numbers.

EXP 4 : Sort an array of numbers in ascending and descending order using assembly language.

EXP 5 : Write an assembly language program to compute (a) Fibonacci series (b) Factorial of a given number.

EXP 6 : Interface LEDs with 8051 and display rolling/flashing LED patterns.

EXP 7 : Interface and control a stepper motor to rotate in forward and reverse directions.

EXP 8 : Perform Analog-to-Digital (ADC) and Digital-to-Analog (DAC) conversions using interfacing circuits.

EXP 9 : Simulate and implement a traffic light controller with different delays using 8085/ 8051.

EXP 10 : Interface 8255 Programmable Peripheral Interface (PPI) to perform port configuration and data transfer.

EXP 11 : Display data on an alphanumeric LCD using 8051 microcontrollers.

EXP 12 : Use Keil or Proteus to simulate applications such as temperature sensing, IR sensors, or motor control.

EXP 13 : Perform interrupt programming and timer control using 8051/ARM.

MP: Mini-project using 8051MC /ARM/ PIC/ AVR etc.

Text Book:

1. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, 6th ed. Stamford, CT, USA: Cengage Learning, 2013.
2. M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd ed. Upper Saddle River, NJ, USA: Pearson, 2008.

Reference Book:

1. N. Sloss, D. Symes, and C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software, 1st ed. San Francisco, CA, USA: Morgan Kaufmann, 2004.

CO-PO-PSO MAPPING

MICROPROCESSOR & MICROCONTROLLERS LAB															
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	3	3	3	3	1	1	1	3	3	1	1	3	3	3
CO2	3	3	3	3	3	2	2	1	3	3	1	1	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	2	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Average	3.0	3.0	3.0	3.0	3.0	2.3	2.0	1.8	3.0	3.0	1.8	1.8	3.0	3.0	3.0
Level of Correlation: 3 - High 2 - Medium 1 - Low															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
ADVANCED COMMUNICATION & SIGNAL PROCESSING LAB	**EI3522**	**0-0-3**	**1.5**

Prerequisite: Basic knowledge of Communication Systems, Signal Processing fundamentals, Digital Electronics and Networking basics

Course Outcomes:

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

CO1: Demonstrate proficiency in handling and processing signals for various communication and signal processing applications.

CO2: Design, simulate, and analyze various communication and networking protocols, focusing on security and transmission.

CO3: Analyze biomedical signals and images in the context of real-life problems and applications.

CO4: Develop practical skills in using advanced simulation tools (MATLAB, LabVIEW, CST, NetSim) for designing and analyzing communication systems.

Software Tools:

Any software tool may be used (MATLAB/LabVIEW/CST/NetSim/Open-source software).

List of Experiments: (Any 8 experiments excluding capstone project)

EXP 1 : **A/D Conversion:** Sample and reconstruct signals to ensure accurate representation of analog signals in digital form.

EXP 2 : **Interpolation/Decimation:** Implement interpolation and decimation processes to understand signal processing techniques.

EXP 3 : **Pseudorandom Sequence Generation:** Generate pseudorandom sequences using Linear-Feedback Shift Register (LFSR) and Chaotic map.

EXP 4 : **Scrambling and Unscrambling:** Scramble and unscramble data using a pseudorandom sequence for secure transmission.

EXP 5 : **Signal Acquisition and Generation:** Implement hardware for signal acquisition and generation (e.g., oscilloscope or signal generator).

EXP 6 : **Noise Removal from Images:** Develop a program to remove salt-and-pepper and Gaussian-type noise from a given noisy image.

EXP 7 : **Channel/Source Coding Simulation:** Study and simulate any channel/source coding schemes for data compression or error correction.

EXP 8 : **Wireless Network Simulation:** Simulate Wireless Sensor Networks (WSN), Mobile Ad-hoc Networks (MANET), or Vehicular Ad-hoc Networks (VANET) using appropriate tools.

EXP 9 : **Network Scenario Creation:** Create a network scenario with 3-4 nodes using TCP/FTP connections between nodes.

EXP 10 : **Optical Fiber Modes Study:** Write a program to study the modes of a step-index cylindrical core optical fiber.

EXP 11 : **Biomedical Signal Processing:** Acquire, visualize, and process biomedical signals like ECG, EEG, or EMG.

EXP 12 : **Anomaly Detection in Biomedical Images:** Apply machine learning-based techniques to detect anomalies in biomedical images.

EXP 13 : **Equalization and Channel Estimation:** Write a program for equalization and implement the Least Mean Square (LMS) algorithm for channel estimation.

EXP 14 : **Antenna Radiation Pattern Simulation:** Simulate the radiation pattern of a half-wave dipole antenna at different frequencies.

EXP 15 : **Microstrip Patch Antenna Design:** Design and simulate a microstrip patch antenna using appropriate simulation tools.

EXP 16 : **Substrate Effects on Antenna Performance:** Analyze the effects of substrate material properties on antenna performance.

EXP 17 : **Yagi-Uda Antenna Array Design:** Design and simulate a Yagi-Uda antenna array using simulation software.

EXP 18 : **Planar Patch Array Antenna Design:** Design and simulate a planar patch array antenna for specific applications

MINI PROJECT: A capstone project should be submitted at the end of the lab course, incorporating knowledge from the experiments conducted.

Text Book:

1. S. Haykin, *Communication Systems*, 5th ed. Hoboken, NJ, USA: Wiley, 2013.
2. J. G. Proakis and M. Salehi, *Digital Communications*, 5th ed. New York, NY, USA: McGraw-Hill, 2008.

Reference Book:

1. B. P. Lathi, *Modern Digital and Analog Communication Systems*, 4th ed. New York, NY, USA: Oxford Univ. Press, 2009.
2. W. Stallings, *Wireless Communications & Networks*, 2nd ed. Upper Saddle River, NJ, USA: Pearson, 2005.
3. J. K. P. Chien, *Biomedical Signal Processing and Artificial Intelligence in Healthcare*, CRC Press, 2021.

CO-PO-PSO MAPPING

ADVANCED COMMUNICATION & SIGNAL PROCESSING LAB															
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	3	3	1	2	2	1	2	1	1	1	1	2	1	1
CO2	3	3	3	2	3	2	2	3	2	2	1	1	3	2	1
CO3	3	2	3	2	2	2	3	2	1	1	1	1	2	1	1
CO4	3	3	3	3	3	3	3	3	2	3	2	2	3	3	3
Average	3	2.7	3	2	2.5	2.2	2.2	2.5	1.5	1.7	1.2	1.2	2.5	1.7	1.5
Level of Correlation: 3 - High 2 - Medium 1 - Low															

SEVENTH SEMESTER

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
COMPUTER ORGANIZATION AND ARCHITECTURE	EI4221	3-0-0	3

Prerequisite: Digital Logic Design, Basic Programming Concepts

Course Outcomes:

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

CO1: Illustrate the basic structure and operation of a digital computer system.

CO2: Analyse the design and operation of arithmetic and logic units including floating-point operations.

CO3: Explain the functioning of control units and instruction execution with pipelining.

CO4: Illustrate hierarchical memory systems including cache and virtual memory.

Module I: Basic Computer Organization **8 Hours**

Functional units, buses, bus arbitration. Registers and memory transfers. Processor organization: general-purpose registers, stack organization. Addressing modes and instruction formats.

Module II: Arithmetic and Logic Unit **7 Hours**

Adders (including look-ahead), signed multiplication (Booth's algorithm, array multiplier), division, floating-point arithmetic, ALU design, IEEE floating-point standard.

Module III: Control Unit & Pipelining **8 Hours**

Instruction types, cycles (fetch/execute), micro-operations, RISC concepts, pipelining, control unit types (hardwired vs microprogrammed), sequencing, horizontal & vertical microprogramming.

Module IV: Memory and I/O Systems **7 Hours**

Memory hierarchy, RAM, ROM, 2D/2.5D memory, cache design, virtual memory. I/O devices, I/O ports, interrupts, data transfer modes (Programmed I/O, DMA), synchronous/asynchronous comm., standard interfaces.

Total lecture hours: **30 Hours**

Text Book:

1. M. Morris Mano, *Computer System Architecture*, Pearson
2. Carl Hamacher et al., *Computer Organization*, McGraw-Hill, 5th Ed.
3. John P. Hayes, *Computer Architecture and Organization*, McGraw-Hill

Reference Book:

1. William Stallings, *Computer Organization and Architecture*, Pearson, 7th Ed.
2. Behrooz Parhami, *Computer Architecture*, Oxford University Press
3. Patterson & Hennessy, *Computer Architecture: A Quantitative Approach*, Elsevier
4. A. S. Tanenbaum, *Structured Computer Organization*, PHI

CO-PO-PSO MAPPING

COMPUTER ORGANIZATION AND ARCHITECTURE															
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	1	-	-	-	-	-	1	-	-	3	1	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
CO4	3	2	1	2	2	-	-	-	-	-	-	-	3	2	-
Average	3.00	2.25	1.50	1.75	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00	3.00	1.75	0.00
Level of Correlation:			3 - High			2 - Medium			1 - Low						

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
WIRELESS COMMUNICATION	EI4223	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: Analyze and evaluate signal propagation characteristics and fading phenomena using theoretical and statistical models.

CO3: Apply and compare multiple access and modulation techniques and evaluate receiver architectures and diversity schemes.

CO4: Analyze MIMO techniques and space-time signal processing and evaluate 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

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 l	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															

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
INFORMATION THEORY & CRYPTOGRAPHY	EI4225	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 and analyse 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					

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
SENSOR & TRANSDUCER	EI4227	3-0-0	3

Prerequisite: Knowledge of Physics & Chemistry.

Course Outcomes:

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

CO1: Apply measurement system characteristics and elastic sensors for accurate calibration.

CO2: Analyze resistive, capacitive, inductive, and electromagnetic sensors using signal conditioning.

CO3: Evaluate advanced sensors like piezoelectric and electrochemical for industrial applications.

CO4: Create smart sensor systems with instrumentation amplifiers and digital interfaces for real-time monitoring.

Module I: **07 Hours**

Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step, and frequency response of first and second order elements, and dynamic error in measurement systems.

Module II: **08 Hours**

Techniques for dynamic compensation, loading effect, signal and noise in measurement system, Propagation of errors. Elastic sensing elements: Bourdon tube, bellows, and diaphragms; force and torque measurement. Basics of Flow Measurement: Pitot-Static Tube, Flow-Obstruction Elements, Centrifugal Force Element, Static Vane Elements, Rotating Vane Systems, Rotameter Float System, Thermoelectric sensing elements: thermocouple laws, characteristics, installation problems, cold junction compensation.

Module III: **08 Hours**

Transducers and sensors, Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), Thermistors, strain gauges and associated bridge circuits. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance, LVDT and RVDT displacement sensors; Electromagnetic sensing elements, push-pull configuration for improvement of linearity.

Module IV: **07 Hours**

Piezoelectric sensor, Piezoresistive Sensor, Instrumentation amplifier, Electrochemical sensor: Ion selective electrodes, Electrochemical gas sensor, chemically sensitive Field Effect Transistors, Hall Sensor, IC temperature sensor. Introduction smart sensors, digital sensors with interfacing fundamentals, and their applications.

Total lecture hours: **30 Hours**

Text Book:

1. Principles of Measurement Systems-J.P. Bentley (3/e), Pearson Education, New Delhi.
2. Introduction to Measurement and Instrumentation-A.K.Ghosh (3/e), PHI Learning, New Delhi.
3. Measurement Systems Application and Design- E.O. Doeblin (4/e), McGraw-Hill, International, NY.
4. Morris, A. S., & Langari, R, Measurement and Instrumentation: Theory and Application (3rd ed.), Elsevier, 2020.

Reference Book:

1. Transducers and Instrumentation-D.V.S. Murthy(2/e), PHI Learning, New Delhi.
2. Instrumentation for Engineering Measurements-J.W. Dally, W.F. Riley and K. G. McConnel (2/e), John Wiley, NY.
3. Sensor Technology Handbook, Jon S. Wilson—Newnes, 2004.
4. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer.

CO-PO-PSO MAPPING

SENSOR & TRANSDUCER															
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	2	2	2	-
CO2	3	2	2	1	-	-	-	-	-	-	-	2	2	2	-
CO3	3	3	3	2	1	-	1	-	-	-	2	2	3	2	1
CO4	3	3	3	3	2	1	-	-	-	-	1	2	3	2	2
Average	3.0	2.5	2.5	2	0.75	0.25	0.25	-	-	-	1	2	2.5	2	0.75
Level of Correlation:					3 - High				2 - Medium				1 - Low		

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
NATURAL LANGUAGE PROCESSING	EI4207	3-0-0	3

Prerequisite: Discrete Mathematics, Probability & Statistics, Data Structures, Basic Python Programming, Machine Learning Fundamentals

Course Outcomes:

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

CO1: Analyze linguistic phenomena and apply formal grammars for modeling word and document structures.

CO2: Implement syntax analysis techniques using treebanks and parsing algorithms to resolve syntactic ambiguities.

CO3: Apply statistical methods to build language models and compute probabilities for language modeling and semantic interpretation.

CO4: Design and evaluate NLP algorithms for semantic parsing and meaning representation using supervised and unsupervised learning.

Module I: Structure of Words and Documents **08 Hours**

Words and their components: Issues and challenges in morphology, morphological models.

Structure of documents: Introduction to document structure analysis, methods, complexity, and performance of different approaches

Module II: Syntax Analysis **07 Hours**

Parsing natural language, introduction to treebanks and their role in syntax, syntactic structure representation. Parsing algorithms, models for ambiguity resolution, multilingual issues in parsing.

Module III: Semantic Parsing **08 Hours**

Introduction to semantic parsing, semantic interpretation, system paradigms, word sense systems and software.

Module IV: Meaning Representation and Language Modeling **07 Hours**

Predicate-argument structure, meaning representation systems, and software. Introduction, N-Gram models, language model evaluation, parameter estimation, language model adaptation, types of language models, language-specific and multilingual/cross lingual modeling issues.

Total lecture hours: **30 Hours**

Text Book:

1. Tanveer Siddiqui, U. S. Tiwary, *Natural Language Processing and Information Retrieval*, Oxford University Press
2. Daniel M. Bikel and Imed Zitouni, *Multilingual Natural Language Processing Applications: From Theory to Practice*, Pearson
3. Daniel Jurafsky and James H. Martin, *Speech and Language Processing*, Pearson Publications

Reference Book:

1. Christopher D. Manning and Hinrich Schütze, *Foundations of Statistical Natural Language Processing*, MIT Press, 2003
2. Rajesh Arumugam, Raja Lingappa Shanmugamani, *Hands-On Natural Language Processing with Python*, Packt Publishing, 2018
3. Jacob Eisenstein, *Introduction to Natural Language Processing*, MIT Press
4. Steven Bird, Ewan Klein, and Edward Loper, *Natural Language Processing with Python*, O'Reilly

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

CO-PO-PSO MAPPING

NATURAL LANGUAGE 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	0	0	0	0	0	1	0	0	3	2	0
CO2	3	3	3	2	1	0	0	0	0	0	0	0	3	3	0
CO3	3	3	3	3	2	0	0	0	0	0	0	0	3	3	0
CO4	3	3	3	2	2	0	0	0	0	1	0	0	3	3	0
Average	**3**	**2.75**	**2.75**	**2**	**1.25**	**0**	**0**	**0**	**0**	**0.5**	**0**	**0**	**3**	**2.75**	**0**
Level of Correlation:					3 - High				2 - Medium				1 - Low		

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
BIOMEDICAL SIGNAL PROCESSING	**EI4209**	**3-0-0**	**3**

Prerequisite: Basic knowledge of Signals and Systems, Biomedical Engineering fundamentals

Course Outcomes:

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

CO1: Illustrate the sources, types, and characteristics of noises and artifacts present in biomedical signals.

CO2: Design time-domain and frequency-domain filters to remove noise and artifacts from biomedical signals.

CO3: Apply various methods for analyzing biomedical signal characteristics.

CO4: Explore advanced techniques for analysis of biomedical signals in time and frequency domains.

Module I: Introduction to Biomedical Signals **08 Hours**

Study of action potentials and their generation. Origin and waveform characteristics of basic biomedical signals such as Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Event-Related Potentials (ERPs), Electrogastrogram (EGG). Objectives and challenges of biomedical signal analysis and introduction to computer-aided diagnosis systems.

Module II: Removal of Noise and Artifacts from Biomedical Signal **07 Hours**

Random and Structured Noise, Physiological Interference, Stationary and Nonstationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering.

Module III: EEG Signal Processing and Event Detection in Biomedical Signals **08 Hours**

Characteristics and analysis of EEG signals. Linear prediction theory and autoregressive methods. Sleep EEG and applications of adaptive filters for noise cancellation in ECG and EEG. Detection of characteristic waves (P, Q, R, S, T), EEG rhythms, transients, correlation analysis, and coherence analysis of EEG channels.

Module IV: Analysis of Nonstationary Signals **07 Hours**

Heart Sounds and Murmurs, Characterization of Nonstationary Signals and Dynamic Systems, Short-Time Fourier Transform, Considerations in Short-Time Analysis and Adaptive Segmentation.

Total lecture hours: **30 Hours**

Text Book:

1. R. M. Rangayyan, Biomedical Signal Analysis, 2nd ed. Hoboken, NJ, USA: Wiley-IEEE Press, 2015.
2. D. C. Reddy, Biomedical Signal Processing: Principles and Techniques. New York, NY, USA: McGraw-Hill, 2005.
3. W. J. Tompkins, Biomedical Digital Signal Processing. Englewood Cliffs, NJ, USA: Prentice Hall, 1993.
4. L. Sörnmo and P. Laguna, Bioelectrical Signal Processing in Cardiac and Neurological Applications. San Diego, CA, USA: Academic Press, 2005.

Reference Book:

1. J. Enderle and J. Bronzino, Introduction to Biomedical Engineering: Biomechanics and Bioelectricity, 3rd ed. San Diego, CA, USA: Academic Press, 2012.
2. S. Cerutti and C. Marchesi, Eds., Advanced Methods of Biomedical Signal Processing. Hoboken, NJ, USA: Wiley-IEEE Press, 2011.
3. K. J. Blinowska and J. Żygierewicz, Practical Biomedical Signal Analysis Using MATLAB. Boca Raton, FL, USA: CRC Press, 2011.
4. D. W. Moran, Neural Signal Processing: Quantitative Analysis of Neural Activity. Cambridge,

MA, USA: MIT Press, 2014.

CO-PO-PSO MAPPING

BIOMEDICAL SIGNAL 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	1	1	-	-	-	-	-	1	-	-	3	1	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
CO4	3	2	1	2	2	-	-	-	-	-	-	-	3	2	-
Average	3.0	2.25	1.5	1.75	0.75	0.0	0.0	0.0	0.0	0.25	0.0	0.0	3.0	2.25	1.5
Level of Correlation:			3 - High			2 - Medium			1 - Low						

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Admission Batch: 2023-24)

SUBJECT NAME	SUBJECT CODE	L-T-P	CREDIT
EVOLUTIONARY COMPUTATION TECHNIQUES	EI4231	3-0-0	3

Prerequisite: Basic Mathematics, Programming, Basics Optimization.

Course Outcomes:

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

CO1: Apply evolutionary algorithms like GA, GP, and ES for optimization problems.

CO2: Analyse selection methods and genetic operators to balance exploration and exploitation.

CO3: Evaluate evolutionary algorithms' effectiveness in scheduling, routing, and feature selection.

CO4: Create multi-objective and hybrid evolutionary algorithms for dynamic and parallel environments.

Module I: **06 Hours**

Introduction to Evolutionary Computation, Core Concepts and Terminology (Population, individuals, fitness functions, solution representations), Genetic operators: selection, crossover, mutation., Genetic Algorithms (GAs), Representation and Fitness Function Design (David E. Goldberg, Chapters 1–4) (A.E. Eiben and J.E. Smith, Chapters 1–2).

Module II: **08 Hours**

Core Evolutionary Techniques: Genetic Programming (GP), Evolution Strategies (Real-valued optimization and self-adaptive mutation, Variants: (μ,λ)-ES, (μ+λ)-ES.), Evolutionary Programming (EP), Differential Evolution (DE), Population Management (A.E. Eiben and J.E. Smith, Chapters 3, 5, 6) (Kenneth A. De Jong, Chapters 2–3).

Module III: **10 Hours**

Advanced Mechanisms and Applications: Selection Mechanisms (Tournament, roulette wheel, rank-based selection, Balancing exploration vs. exploitation), Genetic Operators (Crossover types, Mutation strategies), Applications of Evolutionary Computation (Optimization (scheduling, routing), machine learning (feature selection), engineering design, Theoretical Foundations (Dan Simon, Chapters 4–6, 10–12).

Module IV: **06 Hours**

Multi-Objective Evolutionary Algorithms (NSGA-II, SPEA2, Pareto fronts), Parallel and Distributed EC, Hybrid Approaches and Dynamic Environments, Challenges and Limitations (Kalyanmoy Deb, 2001, Chapters 3–5, 8).

Total lecture hours: **30 Hours**

Text Book:

1. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg, 1989.
2. Introduction to Evolutionary Computing" by A.E. Eiben and J.E. Smith, 2015.
3. Evolutionary Optimization Algorithms by Dan Simon, 2013.
4. Multi-Objective Optimization Using Evolutionary Algorithms by Kalyanmoy Deb,2001.

Reference Book:

1. Introduction to Evolutionary Computing" by A.E. Eiben and J.E. Smith, 2nd Edition, 2015.
2. Evolutionary Computation: A Unified Approach" by Kenneth A. De Jong ,2006.
3. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg, 1989.
4. Evolutionary Algorithms for Solving Multi-Objective Problems" by Carlos A. Coello Coello, Gary B. Lamont, and David A. Van Veldhuizen, 2nd Edition, 2007.

CO-PO-PSO MAPPING

EVOLUTIONARY COMPUTATION TECHNIQUES															
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	1	3	1	-	-	-	-	-	2	3	2	1
CO2	2	3	2	2	1	2	-	-	-	-	-	2	2	3	2
CO3	2	2	3	3	2	3	-	-	-	-	-	2	2	2	3
CO4	3	2	3	2	3	2	-	-	-	-	1	2	3	2	2
Average	2.5	2.25	2.25	2	2.25	2	-	-	-	-	0.25	2	2.5	2.25	2
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
INTRODUCTION TO MICROFABRICATION	EI4205	3-0-0	3

Prerequisite: Basic knowledge of semiconductor physics and electronic devices.

Course Outcomes:

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

CO1: Apply the knowledge of crystal structure, defects, and clean room in crystal growth and wafer cleaning process.

CO2: Analyze the kinetics and process of oxidation in microfabrication

CO3: Evaluate the different lithography schemes and its metrics involved in IC fabrication

CO4: Analyze the advancements in CMOS process fabrication of diffusion, ion implantation, deposition, and CVD technology etching and metallization to evaluate different metrics in microfabrication.

Module I: Introduction **08 Hours**

History of IC's; Operation & Models for Devices of Interest: CMOS and MEMS. Electronic Materials: Crystal Structures, Defects in Crystals, Si, Poly Si, Si Crystal Growth. Clean room and Wafer Cleaning: Definition, Need of Clean Room, RCA cleaning of Si.

Oxidation: Dry and Wet Oxidation, Kinetics of Oxidation, Oxidation Rate Constants, Device Isolation, LOCOS.

Lithography: Overview of Lithography, Radiation Sources, Masks, Photoresist, Components of Photoresist Optical Aligners, Resolution, Depth of Focus, Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography.

Module II: Diffusion and Ion Implantation **08 Hours**

Successive Diffusion, Lateral Diffusion, Diffusion System.

Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Applications in ICs, Ion Implantation System, Ion Implantation Damage, Post Implantation Annealing.

Module III: Thin Film Deposition and CVD **08 Hours**

Physical Vapor Deposition: Thermal evaporation, Resistive Evaporation, Electron beam evaporation, Laser ablation, Sputtering

Chemical Vapor Deposition: Advantages and disadvantages of Chemical Vapor deposition (CVD) techniques over PVD techniques, Different kinds of CVD techniques: APCVD, LPCVD, Metalorganic CVD (MOCVD), Plasma Enhanced CVD etc.

Module IV: Etching & Metallization **06 Hours**

Anisotropy, Selectivity, Wet Etching, Plasma Etching, Reactive Ion Etching.

Metallization: Overview of Interconnects, Contacts, Metal gate/Poly Gate, Problems in Aluminum Metal contacts, Al spike, Electromigration, Metal Silicides, Multi-Level Metallization, Planarization.

Total lecture hours: **30 Hours**

Text Book:

1. Silicon VLSI Technology, Plummer, Deal and Griffin ,1st Edition, Pearson Education, 2009.
2. Fundamental of Semiconductor Fabrication, Sze and May, 2nd Edition, Wiley India, 2009.

Reference Book:

1. Silicon Process Technology, S K Gandhi, 2nd Edition, Wiley India, 2009.

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Syllabus (Admission Batch: 2023-24)

CO-PO-PSO MAPPING

INTRODUCTION TO MICROFABRICATION															
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	3	3	3	1	1	3	1	1	1	-	1	3	3	3
CO2	3	3	3	3	1	1	3	1	1	1	-	1	3	3	3
CO3	3	3	3	3	1	1	3	1	1	1	-	1	3	3	3
CO4	3	3	3	3	1	1	3	1	1	1	-	1	3	3	3
Average	3	3	3	3	1	1	3	1	1	1	0	1	3	3	3
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
ADVANCED ARTIFICIAL INTELLIGENCE	EI4101	3-0-0	3

Prerequisite: Machine Learning, Basic Knowledge of Python.

Course Outcomes:

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

CO1: Apply heuristic search and planning techniques for solving AI problems.

CO2: Represent and reason with knowledge using propositional and first-order logic.

CO3: Design AI systems using statistical and ensemble-based learning techniques in real-world applications.

CO4: Analyze and implement deep learning architectures for intelligent decision-making systems.

Module I: Principles of AI and Search Techniques **06 Hours**

Introduction to AI: Definition, history, types (narrow, general, super AI), applications, State Space Representation, Planning and Production Systems, Uninformed Search: Depth-First Search, Breadth-First Search, Informed Search: Greedy, A, Hill Climbing, Simulated Annealing, Problem Reduction: AND-OR graphs, AO algorithm, Constraint Satisfaction Problems (CSP)

Module II: Knowledge Representation and Reasoning **08 Hours**

Agents and environments, Knowledge-based agents, Propositional Logic, Syntax and Semantics, Logical inference, First-order Logic: Representation, quantifiers, inference, Ontological Engineering and Semantic Networks (Intro)

Module III: Learning Paradigms and Applications **08 Hours**

Forms of Learning: Supervised, Unsupervised, Reinforcement, Ensemble Learning: Bagging, Boosting, Stacking, Probabilistic Models: Naïve Bayes, HMMs, Bayesian Networks, Kernel Machines and Support Vector Machines (advanced aspects), Case Studies: AI in Healthcare, Signal Processing, and Smart Antennas

Module IV: Deep Learning and Neural Architectures **08 Hours**

Computational Graphs for Deep Learning, Feedforward and Deep Neural Networks, Convolutional Neural Networks (CNN) and applications in vision, Recurrent Neural Networks (RNN), LSTM, GRU, Transformers and Attention Mechanisms (Intro), Transfer Learning and Pretrained Models (e.g., BERT, ResNet), Reinforcement Learning: Q-Learning, Deep Q Networks (introductory)

Total lecture hours: **30 Hours**

Text Book:

1. Stuart J Russell, Peter Norwig, Artificial Intelligence – A modern approach, 2015, 3rd edition, Pearson, India.
2. Goodfellow, "Deep learning," Cambridge, Massachusetts: The MIT Press, 2016.

Reference Book:

1. Vinod Chandra S.S, AnandHareendran S., Artificial Intelligence: Principles and Applications, 2020, 2nd Edition, PHI Learning Pvt. Ltd., India
2. Alpaydinethem, Introduction to Machine Learning, 2019, 3rd edition, PHI Learning Pvt. Ltd., India.

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Syllabus (Admission Batch: 2023-24)

CO-PO-PSO MAPPING

ADVANCED ARTIFICIAL INTELLIGENCE															
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					