Electronics & Telecommunication Engineering Department

Curriculum: T Y (E&TC)

Government College of Engineering, Aurangabad
(An Autonomous Institute)
Teaching and Evaluation Scheme from year 2023-24
Third Year - B. Tech. Program in Electronics & Telecommunication Engineering
Semester V

Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
SrNo	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISEII**	**ISEIII**	**ESE**	**Total (100)**
1	PCC	ETPC3017	Electromagnetic Engineering	3	-	-	3	15	15	10	60	100
2	PCC	ETPC3018	Digital Signal Processing	3	-	-	3	15	15	10	60	100
3	PCC	ETPC3020	Digital Communication	3	-	-	3	15	15	10	60	100
4	PCC	ETPC3022	Embedded Systems	3	-	-	3	15	15	10	60	100
5	PCC	ETPC3019	Lab-Digital Signal Processing	-	-	2	1	-	-	25	25	50
6	PCC	ETPC3021	Lab-Digital Communication	-	-	2	1	-	-	25	25	50
7	PCC	ETPC3023	Lab-Embedded Systems	-	-	2	1	-	-	25	25	50
8	PROJ	ETPR3001	Mini-Project I	-	-	2	1	-	-	25	25	50
9	HSMC II			3	-	-	3	15	15	10	60	100
10	OEC II			3	-	-	3	15	15	10	60	100
11	PEC I*		MOOC/NPTEL Course	3	-	-	3	15	15	10	60	100
			Total	**21**	**-**	**08**	**25**	**105**	**105**	**170**	**520**	**900**

Semester VI

Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISEII**	**ISEIII**	**ESE**	**Total (100)**
1	PCC	ETPC3024	Computer Network	3	-	-	3	15	15	10	60	100
2	PCC	ETPC3025	A.I. and M.L.	3	-	-	3	15	15	10	60	100
3	PEC II			2	-	-	2	15	15	10	60	100
4	PEC III			2	-	-	2	15	15	10	60	100
5	PCC	ETPC3026	Lab- AI & ML	-	-	2	1	-	-	25	-	25
6	Audit	ETAU3001	Lab-Computer Network	-	-	2	-	-	-	-	-	-
7	PEC II		Lab – PEC II	-	-	2	1	-	-	25	-	25
8	PEC III		Lab – PEC III	-	-	2	1	-	-	25	-	25
9	PROJ	ETPR3002	Mini-Project II	-	-	2	1	-	-	25	25	50
10	OEC III			3	-	-	3	15	15	10	60	100
11	HSMC III			3	-	-	3	15	15	10	60	100
12	HSMC IV			3	-	-	3	15	15	10	60	100
			Total	**19**	**-**	**10**	**23**	**105**	**75**	**170**	**425**	**775**

Industrial training of a minimum of 4 weeks may be completed after the second/third year, Activities from Group I and Group II may be completed this year which needs to be registered in 8th semester.

***This is a MOOC/NPTEL course. Students have to register and appear for the assignments and examinations conducted by MOOC/NPTEL course only. After submitting the Passing certificate of such a course, students will be awarded the 3 credits by virtue of 'Transfer of Credits'.**

Approved in XXVIIth Academic Council
Dated: 25th Nov 2023

ETPC3017: Electromagnetic Engineering	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	**ISE I : 15 Marks**
	ISE II : 15 Marks
Total Credits: 03	**ISE III: 10 Marks**
	End Semester Exam: 60 Marks

Course Objectives:

- To understand the three-dimensional representation of vector fields and vector calculus. To understand basic laws of electromagnetics
- To understand the Maxwell's equations as applied to static and time varying fields.
- To understand Transmission lines
- To understand complex electromagnetic phenomenon of wave propagation and electromagnetic radiation & Antenna Fundamentals

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

CO1	Gain knowledge of coordinate systems & Understand Basic of Electromagnetics
CO2	Understand the Maxwell's equations
CO3	Carryout Impedance transformation Transmission lines (TL) & TL sections for realizing circuit element
CO4	Characterize wave propagation, understanding Plane wave properties
CO5	Understand the phenomenon of wave propagation and electromagnetic radiation.
CO6	Understand Antenna fundamentals.

Detailed Syllabus:

Unit 1	**Electrostatics &Magnetostatics** Basic of vector calculus, Electric field intensity, Electric flux density and Divergence, Gauss's law, Application of Gauss's Law: Some symmetrical charge distributions, Differential volume element, Divergence. Steady magnetic field, Faraday's law, Ampere's Circuital law, Curl, Magnetic flux.
Unit 2	**Time Varying Fields and Maxwell's Equations** Magnetic boundary conditions, Magnetic Circuit, Potential energy and forces on magnetic materials, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form.
Unit 3	**Transmission Lines** Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.
Unit 4	**Wave Propagation** Wave equation, Poynting vector.Plane waves and properties: reflection and refraction,polarization, phase and group velocity, propagation through various media, Wave propagation in parallel plane waveguide, rectangular waveguide, skin depth.

Unit 5	**Antenna Fundamentals** Antenna parameters, Isotropic radiators, Radiation power density, Radiation intensity, Directivity (D), Front to back ratio, Antenna bandwidth and Antenna beam width.Rectangular and circular waveguides, dipole and monopole antennas, linear antenna arrays.

Mapping of Course outcome with Program Outcomes and Program Specific Outcome

Course Outcome	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2								2				3	2
CO2	2	2	1							2		3		3	2
CO3	2									2		3		3	2
CO4	2	2								2				3	2
CO5	2		1	1					3	2				3	2
CO6	2		1							2		3		3	2

3 – High 2 – Medium 1 - Low

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISEI	ISE II	ISE III	End Semester Examination
K1	Remember	10	00	00	15
K2	Understand	05	10	10	35
K3	Apply	00	05	00	10
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K2	K3	K2
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
ISE I (15 Marks)	05	10	00	00	00
ISE II (15 Marks)	00	00	10	05	00
ISE III (10 Marks)	00	00	00	00	10
ESE Assessment(60 Marks)	15	10	15	10	10

ETPC3018: Digital Signal Processing	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	**ISE I:15 Marks**
Credits: 03	**ISE II:15 Marks**
	ISE III: 10 Marks
	End Semester Exam: 60 Marks

Course description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete time systems as signal processing devices.

- The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation, and analysis DSP systems.
- This course in digital signal processing develops essential analysis and design techniques required for a broad range of disciplines.
- Student familiar with most important methods in DSP, including digital filter design, transform domain processing and importance of signal processor.
- After completion of the subject, the student should be able to understand the design principles and the implementation of digital filters and DFT/FFT, and be able to make use of signal processing concepts and wavelets to perform some simple applications.

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

COl	Interpret, represent and process discrete/digital signals and systems
CO2	Implement frequency domain analysis of discrete time signals of DSP system
CO3	Understand transforms of signals and systems.
CO4	Design and implement digital filters for processing discrete time signals.
CO5	Develop creative and innovative design that achieves desirable performance criteria within specified objectives and constraints for lifelong learning and continuing professional education.
CO6	Understand the theory of DSP processors with programming skills.

Detailed Syllabus

Unit 1	**Discrete-time Systems and General Realization Techniques** Concept of discrete-time signal. Sampling and reconstruction of signal. Time invariance, causality, linearity, periodic, energy, power convolution and LTI systems
Unit 2	**Discrete Time Fourier Transform (DTFT):** Concept of frequency in discrete and continuous domain, frequency response in the discrete domain. **Z- Transforms:** Definition, unit circle, convergence and ROC, properties of Z-transform, characteristic of signals, initial value theorem, Parseval's relation, inverse Ztransform. **Discrete Fourier Transform:** Relation between DTFT & DFT. Twiddle factors and their properties, computation by different methods, filtering of long data sequences **Fast Fourier Transforms:** Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal

	Introduction to Wavelet Transforms
Unit 3	**Design of Infinite Impulse Response Filters** Revision of analog systems, Butterworth filters and Chebyshev filters. Types of digital filters: IIR and FIR. IIR filter design, bilinear transformation, frequency scaling, transformation from prototype low-pass filter to high-pass filter and band-pass filter. Impulse-invariant and/or step-invariant approaches
Unit 4	**Design of Finite Impulse Response Filters** FIR filter analysis, Fourier series approach, windowing, Gibbs phenomenon, commonly used windows, concept of linear phase, frequency transformation, low-pass, band-pass, high-pass filters and filter band design.
Unit 5	**Digital Signal Processors and Applications** 1. Architectures and important instruction sets of TMS320c 5416/6713 2. FPGA: Architecture, different subsystem, design flow of DSP system design, mapping into DSP algorithm into FPGA.

TEXT AND REFERENCE BOOKS

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
3. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucas and W. S. Hodgkis, Digital Signal Processing Wiley and Sons, Singapore, 1988.
5. G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 / PHI.
6. 6. K. Mitra, 'Digital Signal Processing – A Computer Based Approach, Tata McGraw Hill, New Delhi, 2001

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	-	-	2	2	2	-	-		-	3
CO2	2	1	1	2	2	1	1	2	2	2	-	-		1	3
CO3	2	1	1	1	-	-	1	2	2	1	-	-		1	3
CO4	1	1	1	1	1	1	-	1	1	1	-	1		1	3
CO5	1	2	3	2	1	2	2	1		1	1	1	1	1	3
CO6	2	2	2	1	-	2	1	1		1	1	3	1	1	3

3 – High2 – Medium1 – Low

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	05	00	00	06
K2	Understand	10	10	05	42
K3	Apply	00	05	05	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K2	K2	K2
	C01	C02	C03	CO4	CO5	CO6
ISE I (15 Marks)	05	10	00	00	00	00
ISE II (15 Marks)	00	00	05	10	00	00
ISE III (10 Marks)	00	00	05	05	00	00
ESE Assessment (60 Marks)	06	12	10	12	12	08

ETPC3019: Lab-Digital Signal Processing	
Teaching Scheme	**Examination Scheme**
Practical: 2 Hrs/Week	**ISE III: 25 Marks**
Credits: 01	**End Semester Examination: 25 Marks**

Purpose:

The Digital Signal Processing Lab (DSPLAB) provides all the required equipment to implement real-time digital signal processing solutions supporting experimental research, applied research, and industrial projects.
Students simulate the number of experiments in MATLAB. Students also use TMS 320C5416 fixed-point DSP processors. Programing of the DSP chip is done in C(and some assembly) language using the Code Composer Studio integrated development environment.
Equipment: DSP prototype board or FPGA development tools and platforms, Texas Instruments C6727 Floating Point DSP developer kit.

Laboratory Course Outcomes

As an outcome of completing the Laboratory course using MATLAB/CCS/IDE, students will be able to:

CO1	The student will be able to carry out simulation of DSP systems.
CO2	Develop and Implement DSP algorithms in software using a computer language such as C/MATLAB /TMS320C6713 floating point Processor.
CO3	Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters.
CO4	Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital IIR filters.

List of Experiments

The practical part of the work consists of a minimum of eight tasks that should be performed on the RPi /DSP starter board /or MATLAB simulations.

Sr. No.	Details
1	Program for Discrete-time signals and systems, linear coefficients difference equations and realization structures, convolution, and correlation using MATLAB
2	Program for DTFT and DFT Spectral Analysis
3	Program for FFT and Bit reversal
4	Design and implement of FIR filter, FIR filtering interfacing MATLAB and Code Composer Studio
5	Design discrete-time digital filters and implement them in real time.
6	Design and implement of IIR filter
7	Program for Multi-rate Signal Processing Basic Sampling Rate Alteration Devices • Decimator and Interpolator Design and Implementation • Design of Filter Banks • Design of Nyquist Filters
8	Program for STFT Implementation
9	Introduction to Hardware and Software Tools for the TMS320C6748 Board 1. C6000 instruction set architecture or

	2. Developer Kit (LCDK) 3. Or FPGA /Raspberry Pi 3 4. TI Code Composer Studio software tools 5. TI DSP BIOS (operating system) 6. LabVIEW and Matlab
10	Generating a Sine Wave Using the Hardware and Software Tools for the TI TMS320C6711 DSP Processor

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3											3
CO2		3		2										1	3
CO3	2	2		1										1	3
CO4				1		1					1			1	3
CO5	2	1			1								1	1	3
CO6			1			2	2						1	1	3

3 – High2 – Medium1 – Low

Assessment Table

Assessment Tool	S2	S1	S4	S3	S2	S3
	CO1	CO2	CO3	C04	CO5	CO6
ISE III (25 Marks)	05	04	02	05	05	04
Practical Examination & Viva Voce (25 Marks)	05	02	02	10	03	03

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	08	08
S2	Manipulation	05	05
S3	Precision	10	10
S4	Articulation	02	02
S5	Naturalization	00	00
Total		25	25

ETPC3020: Digital Communication	
Teaching Scheme	**Examination Scheme**
Lectures:3 Hrs/Week	**ISE I: 15 Marks**
Total Credits: 03	**ISE II: 15 Marks**
	ISE III: 10 Marks
	End Semester Exam: 60 Marks

Course description: This course covers the fundamentals of digital communication. It deals with pulse modulation and digital modulation techniques. It also covers interference in transmission and probability of error in received signal. Spread Spectrum Modulation is dealt withappropriately.

Course Objectives:

- Understand the fundamentals of digital communication.
- To explain about the pulse modulation and digital modulation techniques
- To make students aware of interference in digital modulated signal
- To give exposure to Spread Spectrum Modulation

Course Outcomes:

After completing the course, students will be able to:

CO1	Define basic concepts of pulse modulation, digital modulation, spread spectrum modulation	K1
CO2	Explain various types of pulse and digital modulation and demodulation techniques	K2
CO3	Formulate mathematical representation of pulse ,digital modulation -demodulation	K3
CO4	Describe the significance of noise in digital communication systems	K2
CO5	Understand the spread spectrum of modulated signal	K2
CO6	Interpret the performance of pulse and digital modulation techniques	K3

Detailed Syllabus:

Unit 1	Pulse modulation: Sampling, Quantization, Pulse code modulation, line coding, T1 Digital System, DPCM, DM, ADM, Voice coder (Vocoders)
Unit 2	Digital Modulation Techniques: Phase shift keying, Quadrature Amplitude shift keying, Frequency shift keying, Pulse shaping, reduction of inter channel and inter symbol interference, regenerative repeaters.
Unit 3	Optimal Reception of Digital Signal: Baseband signal receiver, probability of error, optimum receiver for both baseband and pass band, optimal coherent reception: PSK, FSK, QPSK. Signal space representation and Comparison of modulation system.
Unit 4	Noise in PCM and DM, PCM Transmission, Delta Modulation Transmission, Comparison of PCM and DM , The space shuttle ADM
Unit 5	Spread Spectrum Modulation: Spread Spectrum, Pseudo noise Sequences, DSSS, FHSS and Code Division Multiple Access Ranging

Text books and Reference books

1. H. Taub and D. L. Schilling, "Principles of Communication Systems", 3rd Ed, McGraw-Hill 2012
2. Simon Haykin , "Digital Communications", John-Wiley, 4th Ed , 2006
3. B. Carlson, "Communication Systems: An Introduction to Signals and Noise in Electrical Communication", 5th Ed, McGraw-Hill,2010

4. K S Shanmugam, “Digital and Analog Communication Systems”, John-Wiley & Son,2006
5. R P Singh and S D Sapre, " Communication Systems ",2nd Ed, McGraw-Hill,2007

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	1	1											3	
CO2	2	2	1		1					2				3	
CO3	3	3	2		2									3	1
CO4	2	2	2		1					2				3	
CO5	2	2	2			1	1	2		2				3	
CO6	3	2	2		2									3	1

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

3 –High 2 –Medium 1 – Low

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	05	00	00	06
K2	Understand	10	05	05	42
K3	Apply	00	10	05	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K2	K2	K3
	CO1	CO2	CO3	CO4	CO5	CO6
ISE I (15) Marks)	05	10	00	00	00	00
ISE II (15 Marks)	00	05	10	00	00	00
ISE III (10 Marks)	00	00	05	00	05	00
ESE Assessment (60 Marks)	06	24	06	12	06	06

ETPC3021: Lab Digital Communication	
Teaching Scheme	**Examination Scheme:**
Practical: 2 Hrs/Week	**ISE III: 25 Marks**
	Practical Examination & Viva Voce: 25 Marks

Course Outcomes:

After completing the course, students will be able to:

CO1	Perform various pulse modulation and demodulation techniques	S1
CO2	Perform various digital modulation and demodulation techniques	S2
CO3	Interpret the performance of modulation techniques in presence of noise	S2
CO4	Use modern tools for simulation for modulation	S2

List of Experiments

1.	Study various Line coding techniques
2.	Perform PAM,PWM,PPM
3.	Perform Time DivisionModulation and demonstrate interlacing of at least three waveforms
4.	Perform Pulse Code Modulation and Demodulation and recover original signal
5.	Perform Delta and Adaptive Modulation and Demodulation. Observe change of step size in ADM
6.	Perform Amplitude Shift Keying transmission and reception
7.	Perform Frequency Shift Keying transmission and reception. Find out bandwidth of modulated signal
8.	Perform Phase Shift Keying transmission and reception. Find out bandwidth of modulated signal
9.	Compare performance of digital modulation techniques by EYE diagram
10	Simulate Spread Spectrum modulation technique

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	1		3	2					1				3	
CO2	1	1		2	2					1				3	
CO3	2	2		2	2					1				3	
CO4				2	3					1				3	

3 –High 2 – Medium 1 -Low

Assessment Table

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	03	12	05	05
Practical Examination & Viva Voce (25 Marks)	05	12	04	04

Assessment Pattern

Level No.	**SkillLevel**	**ISE III**	**Practical Exam and Viva-Voce**
S1	Imitation	03	05
S2	Manipulation	22	20
S3	Precision	00	00
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

ETPC3022: Embedded Systems	
Teaching Scheme	**Examination Scheme**
Lectures: 3Hrs/week	**ISE I: 15 Marks**
Total credits: 03	**ISE II: 15 Marks**
	ISE III: 10 Marks
	End Semester Examination: 60 Marks

Course description:
This course introduces the concept of Embedded System, Embedded Microprocessor and its peripherals, interrupts and exceptions, C/ Assembly Programming, Tool Chains, Emulation and Debugging. The course focuses on ARM RISC processors for embedded applications.

Course Objectives:

- To develop understanding about requirements and general design methodology of Embedded Systems.
- To apply hardware and software knowledge for developing Embedded Systems as per requirements, specifications, and constraints.
- To impart knowledge of serial communication protocols, ARM architecture and Real Time Operating Systems.
- To expose the students to recent trends of Embedded System.

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

CO1	Understand classification, design issues & metrics of embedded systems	K2
CO2	Comprehend ARM Basics, ARM architecture, instruction set, assembly language programmingand on-board devices	K2
CO3	Know serial communication protocols	K2
CO4	Interface different peripherals to ARM processor for engineering solutions	K3
CO5	Understand real time systems and System-on chip concepts	K2
CO6	Design Embedded systems for various applications	K3

Detailed Syllabus:

Unit 1	**Introduction to Embedded Systems** Definition of Embedded System, Components of a typical Embedded System, classification, Characteristics, Design Metrics, Overview of Embedded. Processor technology, IC Technology, Design Technology, Hardware components like Microcontroller, GPP, ASSP, ASIP, SoC, Introduction to Real Time non-OS and RTOS systems
Unit 2	**ARM as Embedded Processor** ARM/RISC Design Philosophy, Introduction to ARM processors and its versions, ARM7/ARM9/ ARM11 features, advantages & suitability in embedded application, ARM7 Architecture, differentiation in Cortex Series (A, M, R), data flow model, programmers model, ARM Basics- Register, Stack, Processor modes, System Control Block, Interrupts and Exception Handling, Memory map, GPIO and ARM and Thumb instruction Set
Unit 3	**Communication Interfaces and on-chip devices** Introduction to Serial / Parallel Communication, SPI, I2C, RS232 Serial Port, CAN, USB. **LPC 2148:**Timer/Counter, Watchdog Timer, PWM, ADC, DAC
Unit 4	**Embedded System Development** ARM Assembly Language Programming using Keil, Interfacing of peripherals and programming, Embedded system applications: Home Automation, vending machine or any other

Unit 5	**System on Chip** Introduction to Zynq SoC, Anatomy of Embedded SoC, IP block design, High Level Synthesis, Case Study- Video Processing and Computer Vision on Zynq

Text and Reference Books

1. ARM System Developer's Guide, Andrew N. Sloss, Dominic Symes, Chris Wright, ELSEVIER, 2005, ISBN 8181476468, 9788181476463
2. ARM System-On-Chip Architecture, 2ND ED, Steve Furber, Pearson Education, 2007, ISBN 8131708403
3. Embedded Systems Design, 2ND ED, Steve Heath, Newnes, 2003, ISBN 0750655461
4. Professional Embedded ARM Development, James A. Langbridge, John Wiley & Sons, Inc., 2014, ISBN 9781118788943
5. The Zynq Book, 1ST ED, Louise H. Crockett, Ross A. Elliot, Martin A. Enderwitz, RobertW. Stewart, Strathclyde Academic Media, 2014
6. ARM Assembly Language Fundamentals and Techniques, 2ND ED, William Hohl, Christopher Hinds, CRC Press, 2015, ISBN 9781482229868
7. ARM Assembly Language with Hardware Experiments, Ata Elahi, Trevor Arjeski, Springer, 2014, ISBN 9783319117034
8. PCI System Architecture, 4TH ED, Tom Shanley, Don Anderson, MindShare Inc. PEARSON Education, 2006, ISBN 813170100X

Mapping of Course Outcome with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1	1	1		1		
CO2	2	2	1						1	1	1	1		2	
CO3	3	2	1	1	1				1	1	1	1	2		
CO4	2	2	2	2	2				1	1	1	2			2
CO5	2	2	1	1	1				1	1	2	1	2		
CO6	2	2	2	2	2				2	2	3	2	2		2

3- High 2-Medium 1-Low

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	03	03	00	06
K2	Understand	12	12	00	36
K3	Apply	00	00	10	18
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment Table

Assessment Tool	K2	K2	K2	K3	K2	K3
	CO1	CO2	CO3	CO4	CO5	CO6
ISE I (15 Marks)	10	05	00	00	00	00
ISE II (15 Marks)	00	10	05	00	00	00
ISE III (10 Marks)	00	00	00	05	00	05
ESE Assessment (60 Marks)	12	18	06	12	06	06

ETPC3023: Lab Embedded Systems		
Teaching Scheme	**Examination Scheme**	
Practical: 2 Hrs/Week	**ISE III:**	**25 Marks**
	End Semester Examination:	**25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Use modern engineering tools necessary for integrating software and hardware components in Embedded system designs.
CO2	Write programs in assembly language programming for ARM processor
CO3	Program the basic interfacing of ARM processor with peripherals using Embedded C
CO4	Demonstrate the data communication using SPI/ I2C and exception handling with ARM processor

List of Experiments (Any 8)

Sr. No.	List of Experiments
1	Practice IDE software and universal programmer to program microcontrollers.
2	ARM Instruction set and Assembly language programming 1
3	Program to Interface LEDs to LPC2148 for generating patterns
4	Program to Interface Seven Segment display
5	Program to Interface keys/ key matrix
6	Program to Interface LCD/Graphics LCD
7	Program to Interface Buzzer, relay
8	Program to Interface ADC/DAC
9	Program to Interface Stepper motor/ temperature sensor
10	Use external interrupt to carry out ISR
11	Data communication using SPI/I2C
12	Understand free RTOS tutorial

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PS03
CO1	1	2		1	1					1			2		
CO2	1	2		1	2				2	1			3		
CO3	1	2		2	2				2	1			3	2	2
CO4	2	2		2	2					2			3	2	2

3 – High2 – Medium 1 - Low

Assessment Table

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	03	14	04	04
ESE (25 Marks)	05	12	04	04

Assessment Pattern

Level No.	**Skill Level**	**ISE III**	**ESE**
S1	Imitation	03	05
S2	Manipulation	22	20
S3	Precision	00	00
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

ETPR3001: Mini-Project I	
Teaching Scheme	**Examination Scheme**
Lectures: 2 Hrs/Week	**ISE III:25 marks**
Credits: 01	**Practical /Viva-voce:25 marks**

Course description: The aim of this course is to enable the student to comprehend the principles of modern manufacturing processes / software and to acquire competency in the design, construction, and documentation of electronic equipment/ algorithms.

Course Objectives:

- Elaborate the design processes and production methods.
- Explain the use of software techniques and thermal analysis techniques.

Course Outcomes

After completing the course, students will be able to:

CO1	Identify task and required circuit diagram / system for it.
CO2	Build a project model, simulate, and test it through software.
CO3	Demonstrate working of the project.

Detailed Syllabus:

A group of three or four students shall select a topic from the field of Electronics and Telecommunication Engineering. They have to build a system / mini project / algorithm and test it.

Term Work: It will consist of a report based on the study and actual work done on the selected topic, which will cover theoretical and analytical study of the system, specifications, applications, results etc.

Students are expected to design an IC based project of analogue / digital circuit / software system (This can be used as experimental set-up in the laboratory). PCB design, fabrication, testing and implementation / flow charting, modular design etc. should be done. Students may use the software simulation for verification of hardware implementation. Documentation of the project is to be in standard IEEE format. Project report should include abstract in 100 words (max), key words, introduction, design, simulation, implementation, results/ results comparison, conclusion and references.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

3 – High 2 – Medium 1 - Low

Assessment Pattern

Level	Knowledge Level	ISE III	ESE Practical Viva – Voce
S1	Imitation	05	05
S2	Manipulation	15	15
S3	Precision	05	05
S4	Articulation	00	00
S5	Naturalization	00	00
S1	Imitation	25	25

Assessment table:

Assessment Tool	**S1**	**S2**	**S3**
	CO1	**CO2**	**CO3**
ISE III	05	05	15
Practical / Viva-voce	05	05	15

Semester VI

ETPC3024: Computer Network

Teaching Scheme		Evaluation Scheme	
Lectures	03 Hrs/Week	ISE I	15 Marks
Total Credits	03	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course Outcomes (CO):

1.	Identify the issues and challenges in the architecture of a computer network and recognize security issues in a network.
2.	Enumerate and Explain the function(s) of the layers of the OSI model and TCP/IP Model
3.	Demonstrate the different types of network devices and their functions within a network
4.	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
5	Apprise the skills of sub netting and routing mechanisms
6	Corelate various practical protocols used to assist in network design and implementation

Detailed Syllabus:

Unit 1	**Introduction to Data Communication**: Networks, Protocols and Standards, Categories of Networks, OSI & TCP/IP Protocol suites **Physical layer**: Topology, Guided media, Unguided media, Network Devices.
Unit 2	**Data Link Layer Design Issues**: Framing, Error control, Flow control, Elementary data link protocols (ARQs: Stop and Wait, go back N, Sliding window.), HDLC,PPP. **Medium Access Technique**: Wired LANs: Ethernet, Wireless LANs, CSMA /CD, CSMA/CA, channel allocation, Random Access, Channelization. High speed LAN‟s like FDDI.
Unit 3	**Network Layer & Design Issues**:, IP addressing,IPV4, ARP,RARP, Error reporting protocol ICMP Routing & congestion control algorithms :OSPF & BGP, CIDR & IPV6
Unit 4	**Transport Layer:** Transport Protocols, Addressing, Establishing & releasing a connection Transport protocol for Internet TCP & UDP **Application Layer**: Application Layer Protocols DHCP, DNS, TELNET, FTP, SMTP, HTTP, WWW, VoIP, Introduction to Network security: Goals of Security Basic Cryptography Internet security IPSec
Unit 5	A simple client-server implementation, A simple web server implementation, Networking simulation and modeling techniques. Practical Network Simulators Case studies : Networking using Windows and Linux Operating systems

Text Books:

1. Behrouz A. Forouzan, Data Communications And Networking, 5th Edition, Tata McGraw Hill 2017
2. Andrew S. Tanenbaum, Computer Networks, 4th Edition, Prentice Hall 2003

Reference Books:

1. William Stallings Data And Computer Communication, 8th Edition, Prentice Hall Of India, New Delhi, 2007.
2. Douglas E Comer, Computer Networks And Internet, Pearson Education Asia, 4th Edition2008
3. Larry L. Peterson And Bruce S. Davie, Computer Networks: A Systems Approach, 3rd Edition (2003), Morgan Kaufmann Publishers

Useful Links:

1. http://www.rfceditor.org/rfcsearch.html
2. http://www.cisco.com.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	3	2	-	1	-	-	-	-	-	-	1	-	1	-

CO2	2	3	2	-	1	-	-	-	-	-	-	1	-	1	-
CO3	2	3	2	2	1	-	-	-	-	-	-	1	-	2	-
CO4	2	3	2	2	2	-	-	-	-	-	-	1	-	3	-
CO5	2	3	2	2	2	-	-	-	-	-	1	1	-	3	
CO6	2	3	2	2	2	-	-	-	-	-	1	1	-	3	

3 – High 2 – Medium 1 – Low

Assessment Pattern:

Knowledge Level	ISE-I	ISE-II	ISE-III	ESE
Remember	05	05	00	10
Understand	10	05	05	20
Apply	00	05	05	25
Analyze	00	00	05	05
Evaluate	00	00	00	00
Create	00	00	00	00
TOTAL	15	15	10	60

Assessment Table:

Assessment Tool	K1	K2	K3	K3	K3	K4
	CO1	CO2	CO3	CO4	CO5	CO6
ISE I	05	05	05	00	00	00
ISE II	05	05	05	00	00	00
ISE III	00	05	00	05	00	00
ESE	10	20	10	10	05	05

ETAU3001: Lab Computer Network (Audit)

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	-
Total Credits	-	ESE	-

Course Outcomes (CO):

Student Will be able to

1.	Implement principles of computer networking:
2.	Analyze performance of various computer network
3.	Configure, Model and simulate Data Networks for LAN
4.	Implement, analyze and evaluate networking protocols using Modern tools

List of Experiments:

Experiment 1	Construction of CAT 6/ CAT 7 Ethernet cable (straight/ cross-over).Layer 2 & 3 Switch Data Networking, PC Network TCP/IP configuration
Experiment 2	Execution of Windows Networking Commands such s Ping, Netstat ARP, Netstat, Hostname, Tracert, Ipconfig, NSLookup, Route, PathPing, NetDiag, Telnet, FTP, Netsh Execution of Linux Networking Commands such as ifconfig, ip, traceroute, tracepath, ping, netstat, ss, dig, nslookup, route, host, arp, iwconfig, hostname, curl or wget, mtr, whois, ifplugstatus, iftop, tcpdump
Experiment 3	Software Implementation of Error Detection / Error Correction Techniques a] bit stuffing b] Character stuffing. c] CRC Code.
Experiment 4	Software Implementation of Stop and Wait Protocol and sliding window.
Experiment 5	Software Implementation of Go back-N and selective repeat protocols.
Experiment 6	Create scenario and study IPIV and IPVI addressing scheme
Experiment 7	Implementation of simple client server architecture
Experiment 8	Configuration of Network topology using Packet Tracer.
Experiment 9	Utilization of Wireshark network analyser, Network Simulation tools NS2/NS3
Experiment10	Modelling and Simulation of Network using modern tools Mini project for modelling and simulation of a customized network

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	3	1	2	-	-	-	-	-	-	-	-	2	
CO 2	2	1	3	1	1	-	-	-	-	-	-	-	-	2	
CO 3	1	1	3	1	2	-	-	-	-	-	-	-	-	2	
CO 4	2	1	3	1	3	-	-	-	-	-	-	-	-	2	

3 – High 2 – Medium 1 – Low

ETPC3025: A.I. and M.L.

Teaching Scheme		Evaluation Scheme	
Lectures	03 Hrs/Week	ISE I	15 Marks
Total Credits	03	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description:

The AI part of the course introduces various concepts in the field of artificial intelligence. It discusses how to model a new problem as an AI problem. It describes a variety of models such as search, logic, Bayes nets, and MDPs, which can be used to model a new problem. It also teaches many first algorithms to solve each formulation.

The ML part of the course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. It covers standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbour, naïve Bayes algorithm, support vector machines and kernels. It also covers the basic clustering algorithms and introduces the field of artificial neural network.

The course prepares a student to take a variety of focused, advanced courses in various subfields of AI.

Course Objectives:

1. To understand various concepts & models in AI.
2. To understand various supervised & unsupervised learning algorithms in ML.
3. To Apply the model of AI and algorithms in ML to real world problems.

Course Outcomes

After completing the course, students will able to:

CO1	Learn various concepts in artificial intelligence and machine learning.
CO2	Understand variety of models in AI.
CO3	Understand various supervised and unsupervised machine learning algorithms.
CO4	Understand how to evaluate models generated from data.
CO5	Apply the models of AI & ML to model a real-word problem.
CO6	Apply the concepts learned to understand the frontiers in AI&ML.

Detailed Syllabus:

Unit 1	**Introduction:** Philosophy of AI, Definitions, Modeling a Problem as Search Problem, **Uninformed Search:** Depth First Search, Breadth First Search, Depth First Iterative Deepening **Heuristic Search:** Best First Search, Hill Climbing, Solution Space, TSP, Escaping Local Optima, Stochastic Local Search
Unit 2	**Population Based Methods:** Genetic Algorithms, **Finding Optimal Paths:** Branch & Bound, A*, **Game Playing:** Game Theory, Game Trees, Algorithm Minimax, AlphaBeta Constraint Satisfaction, Propositional Logic & Satisfiability, First Order Logic
Unit 3	Uncertainty in AI, Bayesian Networks, Decision Theory, An introduction to Markov Decision Processes Introduction to Machine learning: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.
Unit 4	Linear regression, Decision trees, overfitting. Logistic Regression, decision tree, k-nearest neighbor, naïve Bayes algorithm, Support Vector Machine, Kernel function and Kernel SVM
Unit 5	Clustering: k-means, hierarchical clustering Neural network: Perceptron, multilayer network, feedforward & back propagation algorithm, introduction to deep neural network

Text Books:

1. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall, Third Edition (2009)
2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.

3. Machine Learning, Tom Mitchell, First Edition, McGraw-Hill, 1997

Reference Books:

1. Artificial Intelligence for Humans, Jeff Heaton
2. Introduction to machine learning, Alex Smola & S.V.N. Vishwanathan

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	3	2								1					
CO2	3	3	2	2									1		
CO3	3	3		2	1		1								
CO4		3		3	3		2		2				2		1
CO5		3							3		2		2		3
CO6						1	1		2				1		1

3 – High 2 – Medium 1 – Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**ESE**
K1	Remember	00	00	00	00
K2	Understand	05	05	00	24
K3	Apply	10	10	05	24
K4	Analyze	00	00	05	12
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	**K2**	**K3**	**K2**	**K3**	**K4**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
ISE I (15 Marks)	05	05	00	00	05
ISE II (15 Marks)	00	00	05	05	05
ISE III (10 Marks)	00	00	00	05	05
ESE Assessment (60 Marks)	06	18	06	18	12

ETPC3026: Lab A.I. and M.L.

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	02	ESE	-

Course Outcomes (CO):

Student Will be able to

1.	Implement different AI algorithms.
2.	Apply AI algorithms on different types of data.
3.	understand different classifiers in machine learning.
4.	Apply classifiers in Machine learning on different dataset.

List of Experiments Any 10 out of 20

01	Implementation of different uninformed search strategis: i) Depth First Search Algorithm , ii) Breadth First Search Algorithm
02	Implementation of Travelling salesman problem (TSP) using Greedy Best First Search Algorithm for the given map of different cities.
03	Implementation of A* search Algorithm for given bidirectional weighted graph. The distance of various nodes from the goal is used as heuristic. Find the path & cost to reach the goal.
04	Implementation of local search algorithm
05	Study of different cross over techniques used in Genetic algorithm.
06	Implementation of constrain satisfaction algorithm- Map coloring
07	Study of markov decision process.
08	Study of Bayesian network.
09	Fit the given set of data points using Linear regression algorithm. Plot the graph and estimate the value for unknown input.
10	Classify the Given dataset using Logistic regression algorithm. Find out the accuracy of the algorithm. (Dataset: Iris dataset or any other dataset with 2 to 4 features)
11	Implement Naive Bayes Classifier (Dataset: with 2 to 4 features). Comment on accuracy, precision and recall rate obtained.
12	Using K-nearest neighbour classifier, classify the mnist dataset (Dataset of 10 numbers). Comment on the misclassified data.
13	Classify the data using SVM classifier.
14	Classify the data using kernel SVM classifier.
15	Evaluate and Compare different Classifiers Experimentally on given dataset (Dataset: Iris dataset or any other dataset with 2 to 4 features).

Mapping of Course outcome with Program Outcomes:

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1	1	-	-	-	-	-	-	-	2	-	1
CO 2	2	1	3	1	3	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	2	1	2	-	-	-	-	-	-	-	1	-	1
CO 4	2	3	2	2	2	-	-	-	-	-	-	-	2	-	1

3 – High 2 – Medium 1 - Low

Assessment Table :

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	05	10	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**ISEIII**
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
S5	Naturalization	00
Total		25

Preparation (S1)	05
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	05
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

ETPR3002: Mini Project – II

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE//Viva-voce	25 Marks

Course description: The aim of this course is to enable the student to comprehend the principles of modern manufacturing processes / software and to acquire competency in the design, construction, and documentation of electronic equipment/ algorithms.

Course Objectives:

- Elaborate the design processes and production methods.
- Explain the use of software techniques and thermal analysis techniques.

Course Outcomes:

After completing the course, students will be able to:

CO1	Identify task and required circuit diagram / system for it.
CO2	Build a project model, simulate, and test it through software.
CO3	Demonstrate working of the project.

Detailed Syllabus:

A group of three or four students shall select a topic from the field of Electronics and Telecommunication Engineering. They have to build a system / mini project / algorithm and test it

Term Work: It will consist of a report based on the study and actual work done on the selected topic, which will cover theoretical and analytical study of the system, specifications, applications, results etc.

Students are expected to design an IC based project of analogue / digital circuit / software system (This can be used as experimental set-up in the laboratory). PCB design, fabrication, testing and implementation / flow charting, modular design etc. should be done. Students may use the software simulation for verification of hardware implementation. Documentation of the project is to be in standard IEEE format. Project report should include abstract in 100 words (max), key words, introduction, design, simulation, implementation, results/ results comparison, conclusion and references.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes:

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

3 – High 2 – Medium 1 - Low

Assessment Pattern:

Level	Knowledge Level	ISE III	ESE/Viva – Voce
S1	Imitation	05	05
S2	Manipulation	15	15
S3	Precision	05	05
S4	Articulation	00	00
S5	Naturalization	00	00
S1	Imitation	25	25

Assessment table:

Assessment Tool	**S1**	**S2**	**S3**
	CO1	**CO2**	**CO3**
ISE III	05	05	15
ESE / Viva-voce	05	05	15

Electronics & Telecommunication

Engineering Department

Curriculum: Final Year

B.Tech. (E&TC)

Government College of Engineering, Aurangabad

(An Autonomous Institute)

Teaching and Evaluation Scheme from year 2024-25

Final Year - B. Tech. Program in Electronics & Telecommunication Engineering

Semester VII

Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISEII**	**ISEIII**	**ESE**	**Total (100)**
1	OEC IV			3	-	-	3	15	15	10	60	100
2	OEC V			3	-	-	3	15	15	10	60	100
3	PEC IV			2	-	-	2	15	15	10	60	100
4	PEC V			2	-	-	2	15	15	10	60	100
5	PEC VI			2	-	-	2	15	15	10	60	100
5	PROJ	ETPR4001	Project - I	-	-	12	6	-	-	50	50	100
6	PEC IV		Lab – PEC IV	-	-	2	1	-	-	25	-	25
7	PEC V		Lab – PEC V	-	-	2	1	-	-	25	-	25
8	PEC VI		Lab – PEC VI	-	-	2	1	-	-	25	-	25
	Total			**12**	**-**	**18**	**21**	**75**	**30**	**175**	**320**	**600**

Semester VIII

Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISEII**	**ISEIII**	**ESE**	**Total (100)**
1	PROJ	ETPR4002	Project – II	-	-	14	7	-	-	100	100	200
2	-	-	Internship in Industry / Research Organization / Premier Institute/ College Assignments	-	-	-	-	-			-	-
3	-	-	Activity I	-	-	-	-	-	-	-	-	-
4	-	-	Activity II	-	-	-	-	-	-	-	-	-
	Total			**-**	**-**	**14**	**7**	**-**	**-**	**100**	**100**	**200**

Activity I - Industrial training of a minimum of 4 weeks / Activities from Group I

Activity II - Activities from Group II

These may be completed earlier and shall have to be registered in 8th semester.

Approved in XXVIIth Academic Council
Dated: 25th Nov 2023

ETPR4001: Project Part – I

Teaching Scheme		**Evaluation Scheme**	
Practical	12 Hrs/Week	ISE III	50 Marks
Total Credits	06	ESE	50 Marks

Course Description: The project work will be carried out by a batch of at the most 4 students (Preferably 3 students) working on topic related to the Electronics, Telecommunications and allied fields. It is also allowed to have a multi-disciplinary work by forming a project group of students from different programmes. The batch will select the topic, by consulting the guide. They have to design and fabricate the system, which will be submitted at the end of second term of current academic year.

Students shall carry field survey and review of literature on selected topic. They shall finalize the methodology and plan implementation stages of project.

ISE III: The batch has to prepare typed report of not less than 25 pages, in format, prescribed which shall include:

- Summary of field survey
- Literature review
- Technical details
- Design
- Related data

Every candidate has to give a talk on the selected topic in presence of staff members and students. The Head of the department will appoint two internal examiners to assess the term work; guide shall be one of the examiners.

Course Outcomes:

CO1	Identify, formulate and review the literature and frame problem statement.
CO2	Plan methodologies and implementation stages.
CO3	Write technical report and deliver presentation.

Mapping of Course outcome with Program Outcomes:

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

3 -High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	K4	K2	A3
	CO1	CO2	CO3
ISE III (50 Marks)	20	20	10

Assessment Pattern:

Level No.	**Cognitive/ Skill/Affective domain Level**	**Term Work**
K2	Understand	20
K4	Analyze	20
A3	Valuing	10
Total		50

Semester VIII
ETPR4002: Project – II

Teaching Scheme		Evaluation Scheme	
Practical	14 Hrs/Week	ISE III	50 Marks
Total Credits	07	ESE &Viva Voce	100 Marks

Course Description:

Project Part-II, is in continuation of Project Part-I undertaken by the candidates in first term. The group of students shall complete the work assigned to them in the first term with faculty guidance.

Group of students shall implement hardware and / or software for planned project. They shall carry module wise testing / debugging, analysis. They shall integrate and validate the specifications under faculty guidance. It is mandatory for students to report weekly progress to guide.

ISE III:

The term work shall consist of a typed report of about 70 pages or more, on the work carried out by the batch of students in respect of the project assigned, during first term and second term. It should be in the prescribed format.

Practical Examination:

It shall consist of demonstration of designed, fabricated project and viva voce based on it. The said examination will be conducted by a panel of two examiners; one of them will be a guide and another will be an external examiner. The external examiner will be either from the allied industry or a senior faculty member from other institute.

Course Outcomes:

CO1	Identify, formulate and review the literature and frame problem statement
CO2	Implement hardware and/or software techniques for identified problems
CO3	Test and analyze the modules of planned project
CO4	Write technical report and deliver presentation
CO5	Apply engineering and management principles to achieve project goal

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	K4	K4 & S3	K4 & S3	A3	A4
	CO1	CO2	CO3	CO4	CO5
ISE III (50 Marks)	10	10	15	10	05
Practical Examination & Viva Voce (100 Marks)	20	20	30	20	10

Assessment Pattern:

Assessment Pattern Level No.	**Cognitive/ Skill /Affective domain Level**	**ISE III**	**ESE Practical Examination & viva voce**
K4	Analyze	10	20
K4 & S3	Analyze & Precision	25	50
A3	Valuing	10	20
A4	Organizing	05	10
Total		50	100

Electronics & Telecommunication

Engineering Department

Curriculum: Professional Electives

List of Professional Elective Courses

Professional Elective	Sr. No.	Course Code	Course Title
I (MOOC/ NPTEL Courses) (3+0+0)	01	ETPE3001	Computer Architecture
	02	ETPE3002	Operating System Fundamentals
	03	ETPE3003	Quantum Computing
	04	ETPE3004 onwards	Any other MOOC/NPTEL course on current technology with the permission of BoS Chairman
II (2+0+1)	01	ETPE3011	Information Theory and Coding
	02	ETPE3012	Lab - Information Theory and Coding
	03	ETPE3013	Optical Fiber Communication
	04	ETPE3014	Lab - Optical Fiber Communication
	05	ETPE3015	Microwave Engineering
	06	ETPE3016	Lab - Microwave Engineering
III (2+0+1)	01	ETPE3021	Object Oriented Programming
	02	ETPE3022	Lab - Object Oriented Programming
	03	ETPE3023	Power Electronics
	04	ETPE3024	Lab - Power Electronics
	05	ETPE3025	Digital System Design
	06	ETPE3026	Lab - Digital System Design
	07	ETPE3027	Industrial Automation
	08	ETPE3028	Lab - Industrial Automation

Professional Elective	Sr. No.	Course Code	Course Title
IV (2+0+1)	01	ETPE4001	Cyber Security
	02	ETPE4002	Lab - Cyber Security
	03	ETPE4003	Big Data
	04	ETPE4004	Lab - Big Data
	05	ETPE4005	Cloud Computing
	06	ETPE4006	Lab - Cloud Computing
V (2+0+1)	01	ETPE4011	Mobile Communication
	02	ETPE4012	Lab - Mobile Communication
	03	ETPE4013	Radar and Satellite Communication
	04	ETPE4014	Lab - Radar and Satellite Communication
	05	ETPE4015	Optical Wireless Communication beyond 5G network
	06	ETPE4016	Lab - Optical Wireless Communication beyond 5G network
VI (2+0+1)	01	ETPE4021	Digital VLSI
	02	ETPE4022	Lab - Digital VLSI
	03	ETPE4023	Digital Image Processing
	04	ETPE4024	Lab - Digital Image Processing
	05	ETPE4025	Robotics
	06	ETPE4026	Lab - Robotics
	07	ETPE4027	Automotive Electronics
	08	ETPE4028	Lab - Automotive Electronics

ETPE3011: Information Theory and Coding

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISEIII	10 Marks
		ESE	60 Marks

Course description: This course describes Information theory, entropy, channels. It also covers various types of codes like linear block codes, cyclic codes, BCH, convolution codes. The subject deals with Information and channels in detail.

Course Objectives:

- To give exposure to students about concepts of information, entropy, coding efficiency
- To explain need of data compression
- To give mathematical foundation of compression, error control and security of information.
- To give exposure to students about various source coding and channel coding

Course Outcomes

After completing the course, students will able to:

CO1	Remember fundamentals concepts of Information theory and source coding	**K1**
CO2	Explain the need of Source coding and Channel coding	**K2**
CO3	Describe various types of Source coding and Channel coding and decoding	**K2**
CO4	Apply theoretical concepts to derive various codes for real world signal	**K3**

Detailed Syllabus:

Unit 1	Information Theory, Entropy, Source coding theorem, Channel models, capacity and coding, Information capacity theorem, Shannon's Limit,
Unit 2	Linear Block Coding/Decoding, Matrix description of Linear block codes, Hamming codes, optimal linear codes, Maximum Distance Separable codes
Unit 3	Cyclic Codes, Polynomials, Generation of Cyclic codes, matrix description of cyclic codes, Burst Error Correction, Fire Codes, Golay Codes, Cyclic Redundancy Check, BCH Coding /Decoding, Primitive elements, Minimal Polynomials, Generator Polynomials, Reed Solomon codes.
Unit 4	Convolutional Code, Tree Codes and trellis codes, Polynomial description of Convolutional Codes, Distance Notion, generating function, Matrix description, Viterbi coding, Distance Bound, Performance bound, Turbo Coding/Decoding.

Text and Reference Books:

1. Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication, 2nd Edition
2. R. Avudaiammal, "Information Coding Techniques" Second Edition. Tata McGraw Hill
3. J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition.
4. Simon Haykin, "Communication Systems", John Wiley & Sons, Fourth Edition.

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1 – Low

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/Field visits/Presentations/Course Projects

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	05	00	00	10
K2	Understand	10	05	00	38
K3	Apply	00	10	10	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K2	K3
	CO1	CO2	CO3	CO4
ISE I (15 Marks)	05	10	00	00
ISE II (15 Marks)	00	05	10	00
ISE III (10 Marks)	00	00	00	10
ESE Assessment (60 Marks)	10	12	26	12

ETPE3012: Lab Information Theory and Coding

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Recognize /calculate entropy, mutual information of given signal	**S1**
CO2	Implement programs to generate various codes	**S2**
CO3	Apply modern tools to code the real world signal	**S2**
CO4	Demonstrate to compare the performance of coded with un-coded signals	**S2**

List of Experiments:

Sr. No.	Details
1.	Write & Execute programs to find out entropies and mutual information of given signals for a given channel. Test various types of channel such as a) Noise free channel b) Error free channel
2.	Write & Execute programs to find out entropies and mutual information of given signals for a given channel. Test various types of channel such as a) Binary symmetric channel b) Noisy channel Compare channel capacity of above channels including experiment a) & b) channel
3.	Write & Execute programs for generation and evaluation of source coding a) Shannon – Fano coding and decoding
4.	Write & Execute programs for generation and evaluation of source coding a) Huffman Coding and decoding b) Lempel Ziv Coding and decoding
5.	Write& Execute Programs for coding & decoding of Linear block codes.
6.	Write & Execute Programs for coding & decoding of Cyclic codes.
7.	Write & Execute programs for coding and decoding of BCH and RS codes.
8.	Write & Execute programs for coding and decoding of convolutional codes
9.	Write & Execute programs to study performance of a coded and uncoded communication
10.	Implement any one type of coding technique for real world 1-D or 2-D signals

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1										1	
CO2		2	1											2	
CO3					2		1		1					2	
CO4			2	2						2				3	

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	10	05	05

Assessment Pattern:

Level No.	Skill Level	ISE III
S1	Imitation	05
S2	Manipulation	20
S3	Precision	00
S4	Articulation	00
S5	Naturalization	00
Total		25

ETPE3013: Optical Fiber Communication

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course covers basics of light propagation in optical fiber, types and structure of optical fiber. It deals with the manufacturing process as well. Signal degradation which includes attenuation and dispersion are discussed in detail. Measurements related to optical fiber are covered.

Course Objectives:

The objectives of the course are to

1. Give exposure to students about components of optical fiber communication link.
2. Explain propagation of light through optical fibers.
3. Make students understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
4. Give exposure to students about various optical networks.

Course Outcomes:

After completing the course, students will able to

CO1	Define basic laws related to communication in optical fiber.
CO2	Illustrate operation of optical fiber communication components and their integration .
CO3	Formulate mathematical representation of light signal at various stages in optical fiber communication.
CO4	Understand the significance of dispersion and attenuation to design optical fiber link.

Detailed Syllabus:

Unit 1	Optical fiber communication link, fiber types and structure, manufacturing technique, fiber connections, signal degradation in optical fiber wave guide : attenuation and dispersion
Unit 2	Optical Sources: Light emitting diode, LASER diode, Optical detectors : PIN diodes, Avalanche photo diode, Optical Amplifiers
Unit 3	Optical Receiver Performance Considerations: Fundamental receiver operation, Receiver noise, Receiver structures, Preamplifiers, High performance amplifiers.
Unit 4	Digital Transmission System: Point to point links, Digital system planning considerations, Analog systems, Distribution Systems, Advanced multiplexing strategies, OTDR.

Text and Reference Books:

- G. Keiser, Optical Fiber Communications (4/e), TMH, 2008.
- Optical Fiber Communications Principles and Practices (4/e) PHI John M. Senior 2010
- J. Gowar, Optical Communication Systems, (2/e), PHI, 2001.
- Ghatak and K. Thygarajan, Introduction to Fiber Optics, Cambridge, 1999.
- G.P. Agrawal, Fiber Optic Communication Systems, (3/e), Wiley, 2002.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	1	1											1	2	
CO2	1	1	2		1								1	2	
CO3	3	2							1	1			1	2	
CO4	1	2	3						1	2	2		1	2	

3 – High 2 – Medium 1 - Low

Assessment:

ISE I	Shall be on the basis of Class Test
ISE II	Shall be on the basis of Class Test
ISE III	Teachers Assessment of 10 marks is based on one of the / or combination of surprise test, Assignments-Numerical solution, quiz, any other activity suggested by course coordinator.

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**ESE**
K1	Remember	04	04	00	12
K2	Understand	06	06	05	36
K3	Apply	05	05	05	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K2
	CO1	CO2	CO3	CO4
ISE I (15 Marks)	04	06	05	00
ISE II (15 Marks)	04	06	05	00
ISEIII (10 Marks)	00	00	05	05
ESE (60 Marks)	12	18	12	18

ETPE3014: Lab Optical Fiber Communication

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Plot the characteristics of optical devices.
CO2	Organize various components of optical fiber communication and establish /set up Transmission-reception link.
CO3	Use modern tools to perform optical fiber communication related measurements.

List of Experiments:

1.	Draw the characteristics of optical sources and detectors
2.	Establish an optical fiber communication link
3.	Examine /measure attenuation
4.	Examine /Measure Numerical Apertures
5.	Measure pulse spreading
6.	Measure power using OTDR
7.	Demonstrate use of connectors ,splicers
8.	Measure bit rate

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO1	PO 2	PO 3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO1 2	PSO 1	PS0 2	PS0 3
CO1	1	1		2									1	2	
CO2	1	1	1	1									1	2	
CO3	1	1			3								1	2	

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
ISE III (25 Marks)	5	10	10

Assessment Pattern:

Assessment Pattern Level No.	Skill Level	ISE III
S1	Imitation	5
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
S5	Naturalization	00
Total		25

	25
Preparation (S1)	5
Conduct of Experiment (S2)	5
Observation and Analysis of Results (S3)	5
Record (S2)	5
Mini-Project / Presentation/ Viva-Voce (S3)	5
Total	

Approved in XXVIIth Academic Council
Dated: 25th Nov 2023

ETPE3015: Microwave Engineering

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: The course introduces Electromagnetic Propagation in free space and in transmission line structures, discusses operation and design of passive and active microwave components and circuits, microwave signal source. The course introduces microwave measurement techniques.

Course Objectives:

- To develop conceptual understanding of microwave generation using Solid State devices.
- To analyze microwave components and system behavior in terms of scattering parameters.
- To impart fundamental knowledge of microwave measurements

Course Outcomes

After completing the course, students will be able to:

CO1	Understand microwave propagation in free space.	K2
CO2	Understand microwave generation	K2
CO3	Understand microwave measurement and new packaging techniques	K2
CO4	Understand microwave passive devices	K2

Detailed Syllabus:

Unit 1	**Fundamental of microwaves:** Free Space Wave and Guided Wave, Modes of Propagation in Rectangular waveguide, Coaxial Line, Flexible waveguide,
Unit 2	**Microwave Passives** Matching Networks, Microwave Filters, Power Divider/ Combiner, Hybrid, Directional Coupler, Circulator, BALUN, Attenuators & cavity resonator.
Unit 3	**Microwave Actives** Two cavity Klystron amplifier, Reflex klystron, Diodes, HBTs, and HEMTs, Small Signal Amplifiers, Low Noise Amplifiers, Power Amplifiers, Voltage Controlled Oscillators
Unit 4	**Microwave Measurements Packaging Technology** Noise Figure, Sources of Noise, Noise Figure Measurements, Phase Noise, Power Measurement, Plastic and Ceramic Package Analysis and effects on circuit performance, LTCC Process,

Text Books

1. Microwave Engineering by DavidM. Pozar, Fourth Edition Wiley E-Text Reg Card, John Wiley & Sons, Incorporated, 2013, ISBN 1118631439, 9781118631430
2. Foundations For Microwave Engineering, 2ND ED, Robert E. Collin, John Wiley & Sons, 2007, ISBN 8126515287, 9788126515288

Reference Books

1. Microstrip Lines and Slotlines, Third Edition (Artech House Microwave Library (Hardcover))3rd Edition,RameshGarg, InderBahl, Maurizio Bozzi, Artech House, 2013, ISBN 1608075354

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1 – Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Recommended Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**ESE**
K1	Remember	05	00	00	10
K2	Understand	10	05	05	30
K3	Apply	00	10	05	20
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	**K2**	**K2**	**K2**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	05	10	00	00
ISE II (15 Marks)	00	05	05	05
ISE III (10 Marks)	00	05	05	00
ESE Assessment (60 Marks)	12	18	18	12

ETPE3016: Lab Microwave Engineering (II)

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Lab Objectives

1. To design, simulate and implement microwave passives on available 2-layer FR4 substrate
2. To design microwave source using off the shelf ICs, implement them on 2-layer FR-4 substrate and evaluate their performance
3. To design microwave transceiver using of the shelf ICs, implement them on 2-layer FR-4 substrate and evaluate their performance

Laboratory Course Outcomes:

After completing the Laboratory course, students will able to:

CO1	Demonstrate design of various microwave circuits in simulation	S1
CO2	Demonstrate design of various microwave circuits on RF board	S2
CO3	Layout MICs and MMICs	S4
CO4	Demonstrate Power Measurements	S4

List of Experiments:

Sr. No.	Details
1	Design, Simulate, Layout and EM Simulate- Microstrip Line, Coplanar Waveguide with Ground, Coaxial Line, Rectangular Waveguide, Plot Current Distribution, E and H Fields
2	Design, Simulate, Layout and EM Simulate- Attenuation Pads, Phase Shifters
3	Design, Simulate, Layout and EM Simulate- Power Dividers, Hybrids, Lange Coupler
4	Design, create 3D geometry of MOSFET, HBT, Simulate and Plot DC characteristics
5	Design and implement RF board for evaluating off-shelf VCO IC, evaluate on power bench
6	Design and implement RF board for transceivers using off-shelf IC, evaluate the link with audio input
7	Study of Vector Signal Generator, Network and Spectrum Analyzers, Noise Figure Measurement Setup and Phase Noise Measurement Techniques
8	Importing 3D files, creating 3D drawings of QFN Plastic Package, Assigning Materials, EM Simulating QFN Packages
9	Study of Ferro LTCC A6S process and design, EM Simulation of Passives
10	Modeling of Inductors, Capacitors and Resonators on LTCC Process
11	Simulation of a Power Amplifier with Wi-Fi IEEE 802.11 a/b/g signal
12	Simulation of Low Noise Amplifier characteristics- Gain, Return Loss, Noise Figure

Mapping of Course outcome with Program Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	1			3											
CO2				2											
CO3				2								2			
CO4	3			3								3			

3 – High 2–Medium 1-low

Assessment table:

Assessment Tool	S1	S2	S2	S3
	CO1	CO2	CO3	CO4
ISEIII (25 Marks)	02	09	09	05

Assessment Pattern:

Assessment Pattern Level No.	**Skill Level**	**ISEIII**
S1	Imitation	02
S2	Manipulation	12
S3	Precision	05
S4	Articulation	06
S5	Naturalization	00
Total		25

ETPE3021: Object Oriented Programming

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course presents the philosophy of Object-Oriented Programming using C# Language and .NET Framework. Students will be able to apply Object Oriented Programming to Engineering Problems related to signal processing, multimedia storage and communication, graphics, application, and system software development.

Course Objectives:

- To understand the concepts of Object-Oriented Programming using console applications
- To understand the concept of Windows Forms and Form Control Components
- To apply the Events and Delegates to Windows Applications

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

CO1	Remember basic concepts of Object-Oriented Programming	**K1**
CO2	Understand concepts of Events, Delegates and Exceptions	**K2**
CO3	Understand concepts of Windows forms & Application Development	**K2**
CO4	Apply the concepts of programming to Image Processing	**K3**

Detailed Syllabus:

Unit 1	**Introduction to NET Framework** Overview of .NET Framework- Mixed language development and portability, .NET Assembly and Common Language Runtime, Common Type System and Common Language Specification, Base Class Libraries, Namespaces. Managed Vs. Unmanaged Code, Garbage Collector, Introduction to Visual Studio, and Anatomy of C #Program.
Unit 2	**C# Programming Basics** Console Application, Data Types as objects, Iteration and branching constructs, Arrays, Value Type and Reference Types, Methods, Classes and Objects, Interfaces, Exception Handling, Events and Delegates, File I/O.
Unit 3	**Windows Forms** Introduction to Windows Forms, Form Controls and Properties, Dialogs, Drawing Basics, Callback functions, Tablet API, Ink as data object, XML schema, Introduction to XAML and use of Windows Presentation Foundation (WPF).
Unit 4	**Application Development** Graphic Calculator, Image Processing System, Introduction to Multithreading, Multiple Document Interface (MDI) GUI, EDA Software Architecture.

Text Books:

1. Pro C# and the .NET 4.5 Framework, Sixth Edition, Andrew Troelsen, Apress, 2012, ISBN 978-1-4302-4233-8
2. Windows Forms Programming in C#, Chris Sells, Addison Wesley, ISBN 0321116208
3. C# How to Program, Deitel, J. Listfield, T.R. Nieto, C. Yaeger, M. Zlatkina, ISBN 0130622214

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1 – Low

Assessment:

ISE I:	Shall be based on Class Tests/Assignments/Quizzes/Field visits/Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/Quizzes/Field visits/Presentations/Course Projects

Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	05	00	00	10
K2	Understand	10	05	05	24
K3	Apply	00	10	05	16
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K2	K3
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	10	05	00	00
ISE II (15 Marks)	00	10	05	00
ISE III (10 Marks)	00	00	05	05
ESE Assessment (60 Marks)	10	16	16	18

ETPE3022: Lab Object Oriented Programming (III)

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Lab Objectives:

1. Learn Core C# programming Constructs
2. Learn Windows Form and its Controls
3. Learn Software Package Architecture, design and deployment

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Understand .NET Framework, Base Class Libraries, Anatomy of C# programs, core C# constructs, basic concepts of oops in C#	S1
CO2	Design small application packages	S2
CO3	Learn external APIs	S2
CO4	Learn software obfuscation and deployment	S2

List of Experiments:

Sr.no.	Details
1	Installation of Object Oriented Platform (such as Microsoft visual studio)
2	Write and execute console application to display messages and read inputs from user
3	Write and execute console application to explore branching and iteration
4	Write and execute console application to define a class and instantiate its objects
5	Write and execute console application to demonstrate function and operator overloading
6	Write and execute console application to explore inheritance from class and interface
7	Write and execute windows application to design a calculator
8	Write and execute windows application to read a colored image, display Red, Green and Blue components and plot their histogram
9	Write and execute a program to perform 2D convolution of image with a filter
10	Write and execute a program for Snake and Ladder game
11	Write and execute a program to draw line, circle, polygon, rectangle using mouse
12	Write and execute a program with ink API and convert writing to text
13	Develop setup file of Image processing system (for ex. Experiment no. 8) and deploy on the Windows operating system.

Mapping of Course outcome with Program Outcomes:

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

3-High 2–Medium 1 –Low

Assessment Table:

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	10	05	05

Assessment Pattern:

Level No.	**Skill Level**	**ISE III**
S1	Imitation	05
S2	Manipulation	20
S3	Precision	00
S4	Articulation	00
S5	Naturalization	00
Total		25

ETPE3023: Power Electronics

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: Power electronics deals with the application of solid-state electronics for the control and conversion of electric power. The course is an introduction to power converters and its application. It provides a basic knowledge of circuitry for the control and conversion of electrical power with high efficiency. These converters can change and regulate the voltage, current, or power.

Course Objectives:

To enable students to gain knowledge and understanding in the following aspects:

- To enhance knowledge and understanding of power electronic devices and their application in power electronic converters and selection of components for different applications
- The concepts and operating principles of power electronics circuits.
- Design procedures and techniques of power electronics systems & Design of power electronics circuits such as DC/DC, AC/DC, DC/AC and AC/AC converters
- To enhance the knowledge and understanding of power electronic converters and their application in power electronic systems
- To provide students with the skills and techniques necessary to analyze and synthesize power electronic circuits utilizing modern power electronic devices.

Course Outcomes: After completing the course, students will able to:

CO1	Identify Power Semiconductor devices and mechanisms to trigger and commutate	K1
CO2	Understand circuits of trigger and commutation, controlled rectifiers, choppers and inverters	K2
CO3	Explore applications of Power Devices	K2
CO4	Solve the numerical related to power devices, controlled rectifiers, choppers and inverters	K3

Detailed Syllabus:

Unit-I	**Power Semiconductor Devices**: Power diodes, power transistors, power MOSFET, IGBT, SCR, GTO, TRIAC, DIAC, UJT, PUT- construction, steady state and switching characteristics, performance parameters, SCR protection circuits.
Unit-II	**Triggering and Commutation of SCR**: R and RC triggering, UJT triggering circuits, different commutation techniques – circuits and principles of operation.
Unit-III	**Phase Controlled Rectifiers**: Phase angle control, phase-controlled rectifiers, single phase half control and full wave controlled converter, Introduction to cycloconverter.
Unit-IV	**Chopper& Inverter:** Basic chopper classification, basic chopper operation, control strategies, chopper configuration, thyristor chopper circuit, Source filter. Classification of inverter, Series, parallel, bridge inverter, sinusoidal PWM-introduction to space vector modulation -Current Source Inverter. Power electronics applications: Industrial drives chopper-controlled drives, Induction heating, UPS and SMPS.

Text and Reference Books

1. P.C. Sen, "Power Electronics", Tata McGraw Hill
2. M.H. Rashid, "Power Electronics", John Wiley & Sons
3. General Electric, "SCRmanual"
4. G. K. Dubey, S. R Doradle, "Thyristors Power Controller"
5. J. M. Jalnekar and N. B. Pasalkar, "Power Electronics" Technical Publication
6. M D Singh and K. B Khanchandani, "Power Electronics", Tata McGraw Hill
7. B.K.Bose, "Power Electronics & A.C. Drives", Prentice Hall, 1986

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO3	PO4	PO 5	PO 6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	1	-	-	-	-	-	-	-	1	1	-	2	1	-
CO2	2	2	-	-	-	-	-	-	-	1	1	-	2	1	-
CO3	2	2	-	-	-	-	-	-	-	1	1	-	2	-	-
CO4	2	2	-	-	-	-	-	-	-	1	1	-	2	1	-
CO5	2	1	-	-	-	-	-	-	-	1	1	-	2	1	-
CO6	3	2	1	-	-	-	-	-	-	2	1	-	2	1	-

3 – High 2 – Medium 1 - Low

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/Field visits/Presentations/Course Projects

Recommended Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	05	00	0	12
K2	Understand	10	15	10	36
K3	Apply	00	00	00	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K2	K3
	CO1	CO2	CO3	CO4
ISE I (15 Marks)	10	05	00	00
ISE II (15 Marks)	00	10	00	05
ISE III (10 Marks)	00	05	00	05
ESE Assessment (60 Marks)	12	30	06	12

ETPE3024: Lab Power Electronics

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

CO1	Understand the principles of operation, simulation and design procedures of ac-dc , dc-dc converter, dc-ac inverters
CO2	Understand the principles of operation, simulation and characteristic of power devices, method of turn on and turn off of SCR
CO3	Implement set up and test power electronic circuits in the laboratory
CO4	Use Simulation tools.

List of Experiments:

Sr. No.	Details
1	Plot the V/I characteristics of power devices.
2	Implement Firing circuit of SCR and design of Snubber circuit.
3	Perform the commutating circuits of SCR.
4	Plot the TRIAC and DIAC characteristics.
5	Perform Single phase, thyristor –bridge converter with R/RL load
6	To study Series inverter.
7	To study Performance of parallel inverter using two thyristors.
8	Implement SCR application (Any one).
9	Implement the performance of chopper circuit using SCR (DC chopper).
10	To Study of cyclo-converter circuit using thyristors.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
CO4	2	-	-	2	2	-	-	-	-	-	-	-	2	-	-

3 – High 2 – Medium 1 - Low

Assessment Table :

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	04	07	07	07

Recommended Assessment Pattern:

Assessment Pattern Level No.	Skill Level	ISE III
S1	Imitation	04
S2	Manipulation	21
S3	Precision	00
S4	Articulation	00
55	Naturalization	00
Total		25

ETPE3025: Digital System Design

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course introduces the concept of hardware design and implementation using Hardware Description Languages like VHDL. Students also learn about the architectures of different Programmable Logic Devices like PAL, PLA, CPLD, FPGA etc. Students will be able to simulate and test hardware and optimize their designs. They will learn about the use of FPGAs in digital design and the full FPGA design flow.

Course objectives: The course has the following objectives:

- To introduce the fundamental principles of VLSI circuit design
- To obtain comprehensive knowledge about VHDL language to implement digital systems.
- To expose the students to write test bench, synthesize and simulate programs
- To acquaint them with integrated circuit designing using CAD tools and Hardware Description Languages
- To explain architectures of different programmable devices.

Course Outcomes: After completing the course, the students will able to:

CO1	Identify the different process steps in HDL design flow, basics of VHDL and architectures.	**K1**
CO2	Implement combinational and sequential digital circuits using different styles of modeling and Finite State machines	**K2**
CO3	Prepare a design of digital systems to meet a given set of specifications using VHDL or finite state machines.	**K3**
CO4	Understand simulation, synthesis process and architectures of programmable devices	**K2**

Detailed Syllabus:

Unit 1	**Fundamentals of VHDL and Modeling Styles** Introduction to HDL, HDL design flow, VHDL, Features of VHDL, Levels of Abstraction, Language Constructs, Entity, Architecture, Data types, constants, Signals and variables, Libraries and Packages, Functions and Procedures. Dataflow modelling: concurrent statements. Behavioral Modeling: Process statement, Inertial and Transport Delay Models, Signal Drivers, Sequential statements, IF, CASE, NULL, Loop, Wait, Exit, Next statements, Assertion and Report statements, block statement. Structural Modeling: Component declaration, component instantiation, Generics.
Unit 2	**Combinational Logic Design Using VHDL** VHDL modeling of basic gates, half and full adder, subtractor, multiplexers, multiplier, ALU, decoders, parity checker, Comparator, priority encoder, (Dataflow, behavioral and structural modeling), Introduction to Verilog.
Unit 3	**Sequential Logic Design Using VHDL** VHDL modeling of D, T, JK, Shift Registers, Counters, Implementation of Moore and Mealy Machines, Asynchronous Sequential Machines, Applications like Traffic light controller, lift controller or any other.
Unit 4	**VHDL Simulation and Synthesis** Writing a Test Bench, Simple examples of Test Benches, Compilation and Simulation of VHDL code, Simulation deltas, Synthesis Process, RTL Description, Translation, Boolean Optimization, Mapping to Gates, Architecture of PAL, PLA, CPLD and FPGA.

Text and Reference Books
1. Charles Roth, “Digital Design with VHDL”, Thomson Learning, India Edition 2. John Wakerly, “Digital Design: Principal and Practices”, Pearson Education 3. Douglus Perry, “VHDL Programming by example”, TMH, fourth edition 4. J. Bhasker, “VHDL Primer”, PHI 5. J. Bhasker, “A VHDL synthesis Primer”, BSP, New Delhi 6. Wayne Wolf, "FPGA-Based System Design," Prentice Hall

Mapping of course outcome with program outcomes:

Program outcome / Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		3				3							1		
CO2			2		3				2		2		2		
CO3			1		1				1		2	2	3		
CO4		2			2								1		

3-High 2-Medium 1-Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	shall be Teachers Assessments of 10 marks is based on one of the/or combination of few of Simulation/ Presentation of case studies/Question and Answer/Numerical solution /On Board Application Development

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	05	00	00	06
K2	Understand	10	10	05	42
K3	Apply	00	05	05	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks (100)		15	15	10	60

Assessment Table:

Assessment Tool	K1	K2	K3	K2
	CO1	CO2	CO3	CO4
ISE I (15 marks)	05	10	--	--
ISE II (15 marks)	--	10	05	--
ISE III (10 marks)	--	05	05	--
ESE Assessment (60 marks)	06	24	12	18

ETPE3026: Lab Digital System Design (III)

Teaching Scheme		**Evaluation Scheme**	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Demonstrate HDL design flow with the help of CAD design tools
CO2	Execute programs using VHDL with different modeling techniques and finite state machines
CO3	Synthesize, simulate and download programs on FPGA platforms

List of Experiments: (Minimum eight)

Sr. No.	**Name of the experiment**
1.	Demonstrate and practice to use CAD design tools to model digital circuits.
2.	Implement simple circuits using data flow modeling: Gate, half adder, MUX, function
3.	Write simple VHDL programs to use different operators of VHDL: relational, logical, data types
4.	Implement combinational circuits using data flow modeling (conditional statement): MUX, Decoder, Prime number. Write test bench to generate waveforms and hardware.
5.	Implement combinational digital circuits using behavioral modeling: Priority Encoder, full adder, parity generator/checker. Write test bench to generate waveforms and hardware.
6.	Implement sequential digital circuits using behavioral modeling: D, J-K flipflops, 3-bit counter, up/down counter, ring counter. Write test bench to generate waveforms and hardware.
7.	Implement digital circuits using structural modeling: 4-bit adder using half and full adder, 8-bit inverter using 1-bit inverter, 8:1MUX using 2:1 MUX. Write test bench to generate waveforms.
8.	Implement types of counter with 1 Hz frequency to download on FPGA platform: 4-bit counter, decade counter, ring counter. Write test bench to generate waveforms and hardware.
9.	Implement FSMs using VHDL: Mealy and Moore Machines
10.	Write simple Verilog programs. (Any four programs).
11.	Design and develop Lift/Traffic controller on FPGA.

Mapping of Course outcome with Program Outcomes:

Course Outcome	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					2								2		
CO2				2	1						2	3	3		
CO3				2	1						2	1	1		

3 – High 2 – Medium 1 – Low

Assessment Table: ISE III: ISE III shall be Term work, consisting of record of experiments/assignments based on the syllabus. The experiments will comprise of Modeling, Simulation and Synthesis and Hardware verification using programmable logic Target boards using Xilinx ISE/Aldec / Vivado

Assessment Tool	**S1**	**S2**	**S2**
	CO1	**CO2**	**CO3**
ISE III : Term Work (25 Marks)	05	16	04

ETPE3027: Industrial Automation

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: After completing this course, students will have a broad and fundamental understanding of industrial automation. Topics range from an overview of common automation industries to an introduction of basic automated system components, such as controllers, I/O, drives, and HMI (Human Machine Interface). In addition, students will learn common automation 3terminology, tools used in industrial automation, and career options available within this field

Course Objectives:

- To provide a clear view on Programmable Logic Controllers (PLC), SCADA and DCS
- To accustom with various methods involved in automatic control and monitoring
- To impart knowledge about robotics, fuzzy Neuro controllers used in automation
- To familiarize with industrial communication protocols

Course Outcomes :

After completing the course, students will able to:

CO1	Develop the PLC programming skills of timing and sequencing operations.
CO2	Identify the necessity of using DAS, SCADA, and DCS & PLC for Complex projects.
CO3	Understand the interfacing methods and industrial communication protocols
CO4	Understand the process control system principle

Detailed Syllabus:

Unit 1	Signal Conditioning Systems Data Acquisition systems, Data Loggers, Industrial Programmable logic controllers (PLC), Programming techniques, SCADA, Distributed Control Systems (DCS). Human Machine Interface
Unit 2	Introduction to industrial communication protocols- TCP/IP protocol- HART communicator protocol Wireless communication (Ip56, Ip58) LAN – PROFI bus, PROFI Net, Modbus, CAN bus, fieldbus architecture, I/O Link and Industrial Ethernet
Unit 3	Process Control system principles, Basic concepts, Industrial pneumatic and hydraulic systems, SEAL 2 & 3 systems.
Unit 4	Fuzzy Neuro Controllers Development of automation systems to industrial processes, IoT, Case studies

Text and Reference Books:

- Bela G. Liptak, Instrumentation Engineer "s Hand Book,CRC Press
- H. S. Kalsi, Electronic Instrumentation, TMH
- J.Nagrath&M.Gopal,Control System Engineering, Third edition, New Age International Publication Rangan and Sarma, Instrumentation Systems, TMH
- Helfric A.D & Cooper W.D, Modern Electronic Instrumentation &Measurement Techniques, Pearson Education
- Curtis D Johnson, Process Control; Instrumentation Technology, Pearson Education, 2008
- PLC manuals from Siemens G.C.Goodwin, S.R.Graebe, M.E. Salgado, Control System Design, Pearson Education

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1					2			1				1	2		3
CO2		1										2	2		
CO3												1		2	
CO4															

3 – High 2 – Medium 1– Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Recommended Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE-II	ISE III	ESE
K1	Remember	05	05	00	10
K2	Understand	10	10	00	25
K3	Apply	00	00	10	25
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

ETPE3028: Lab Industrial Automation

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Explore PLCs, SCADA, DCS, controllers, motors, actuators, encoders, sensors, and PID loops in automation systems.
CO2	Develop an understanding of economic issues related to industrial Robotic and automation systems.
CO3	Participate in a group atmosphere for the defining, planning, and execution of an open ended Automation problem.
CO4	Communicate effectively both verbally and in written form through the preparation of journal report and practical presentation.

List of Experiments:

Sr. No.	Details
1	Analyze PLC, SCADA and write a PLC program for a defined timing and sequence operation
2	Industrial visitfor study of SCADA/ DCS implementation.
3	Applications of various types of practical sensor and its interfacing with systems.
4	Implementation/ Simulation of application of automation to any manual systems.
5	Design and development of a tiny robotic systems.
6	Development of simple computer vision systems.
7	Analyze various industrial communication protocols.
8	Development of Automation system for industrial process.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1				3	2	1						3	1		
CO2		1		3	1							2		2	
CO3				3							2	1			
CO4			2		1					3					

3 – High 2 – Medium 1 - Low

Approved in XXVIIth Academic Council
Dated: 23rd Nov 2023

Assessment Table:

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	04	05	10	06

Assessment Pattern Level No.	Skill Level	ISE III
S1	Imitation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
S5	Naturalization	00
Total		25

ETPE4001: Cyber Security

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course Outcomes (CO):

Upon successful completion of this course, the student will be able to

1.	Identify the issues and challenges in the Cyber security
2.	Enumerate and Explain the function(s) of the security mechanisms
3.	Demonstrate the different types of practical devices and their functions for providing cyber security
4.	Analyze the security requirements for a given organizational structure

Course Contents:

Unit 1	Introduction to Cyber Space, Need for Cyber Security, Introduction to Cyber Attacks Classification of Cyber Attacks, Classification of Malware, Threats, Vulnerability Assessment Risk Analysis, Cyber Security Awareness
Unit 2	Introduction to User Authentication Methods, Biometric Authentication Methods,.Biometric Systems, Different Security Models and Security Mechanisms, Operating System Security, Firewall & Intrusion Detection & Prevention Systems
Unit 3	Web Security, Email Security, Mobile Device Security, Cloud Security, IoT Security, Cyber Physical System Security, Social Media Security
Unit 4	Virtual Currency, Block Chain Technology, Security Auditing, Digital Forensics, History, Challenges Digital Forensic Investigation Methods, Cyber Law-Basics, Information Technology Act 2000 Amendments to IT Act 2000

Text Books:

1. https://heimdalsecurity.com/pdf/cyber_security_for_beginners_ebook.pdf
2. Cryptography and Network Security, Behrouz A. Forouzan, TMH, Third Edition
3. Cryptography and Network Security, William Stalling, Pearson Education
4. Cryptography and Network Security, Atul Kahate, TMH.

List of Reference Sources for Classes and Assignments:

Resources available on e-learning site http://www.e-gecaect.com

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Mapping of Course outcome with Program Outcomes:

PO → CO ↓	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	2	3	2	-	2	-	-	-	-	-	-	2	1		-
CO2	2	3	2	-	2	-	-	-	-	-	-	2	1		-
CO3	2	3	2	2	2	-	-	-	-	-	-	2	2		-
CO4	2	3	2	2	2	-	-	-	-	-	-	2	3		-

3 – High 2 – Medium 1 – Low

Assessment Pattern (with revised Bloom's Taxonomy):

Knowledge Level	**ISEI**	**ISEII**	**ISEIII**	**ESE**
Remember	05	05	00	10
Understand	10	05	05	20
Apply	00	05	05	25
Analyze	00	00	05	05
Evaluate	00	00	00	00
Create	00	00	00	00
TOTAL	15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K3
	CO1	CO2	CO3	CO4
ISEI(15)	05	05	05	00
ISEII (15)	05	05	05	00
ISEIII(10)	00	05	00	05
ESE Assessment (60 Marks)	10	20	10	10

ETPE4002: Lab Cyber Security

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Perform Security Management of an organization
CO2	Provide protection to desktop and mobile operating system
CO3	Use various network protection tools
CO4	Analyze practical firewall system

List of Experiments: Any Six Experiments

Sr. No.	Details
1	Analysis of Security Management of Corporate
2	Hardening of Operating system
3	Demonstration of Cloud Security
4	Web application security implementation
5	Evaluation of Firewalls, VPNs, Intrusion Detection, and filters
6	Email Security Methods
7	Understanding Android Security.
8	Linux security system
9	Techniques of IoT security

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1									1
CO2			3									1
CO3			3				1					3
CO4			3					2				2

3 – High 2 – Medium 1 - Low

Assessment Table :

Assessment Tool	S1	S3	S4	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	05	10	05

Recommended Assessment Pattern :

Assessment Pattern Level No.	**Skill Level**	**ISEIII**
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
S5	Naturalization	00
Total		25

ETPE4003: Big Data

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description:

This course provides terminologies and the core concepts behind big data problems, applications, systems and the techniques that underlie today's big data computing technologies.

It provides an introduction to some of the most common frameworks, Large scale data storage technologies and Big Data Streaming Platforms that has made big data analysis easier and more accessible.

It also introduces various applications of Big Data Analytics using Machine Learning, Deep Learning, Graph Processing and many others.

Course Objectives:

1. To understand the concepts and challenges of Big Data analytics.
2. To learn the Framework, data storage, streaming technologies
3. **Course Outcomes:**
4. After completing the course, students will able to:

CO1	Understand the main challenges of Big Data Processing
CO2	Learn about big data processing pipeline
CO3	Understand the internal architecture & data flow in Apache Spark
CO4	Apply the knowledge for supervised and unsupervised machine learning on large scale data

Detailed Syllabus:

Unit 1	Introduction to Big Data: What is Big Data? What are the challenges? Introduction to Apache Hadoop and Map Reduce, Introduction to Enabling Technologies for Big Data
Unit 2	Introduction to Big Data Platforms: Hadoop, Map Reduce, Bottleneck in Hadoop, Apache Spark. Spark programming. (Python and PySpark), Spark - Resilient Distributed Dataset (RDDs) Introduction to Big Data Storage Platforms for Large Scale Data Storage: in-memory key/value storage systems, NoSQL distributed databases, Apache Cassandra, HBase
Unit 3	Introduction to Big Data Streaming Platforms for Fast Data: Apache Spark Streaming, Apache Kafka Streams Introduction to Big Data Applications (Machine Learning), Numerical, probabilistic and Bayesian modeling, Spark ML library, supervised and unsupervised learning
Unit 4	A case study on Big data Machine learning with Spark in NLP Big Data Applications: Graph Processing

Text and Reference Books

1. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014
2. Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, W. W. Norton & Company, 2014.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PS O2	PS O3
CO1	3														2
CO2	3	2	2	2									1		
CO3	3	2	2	2		2			3	3		3	1		2
CO4		2	3	2		2			3	3		2	1		

3 – High 2 – Medium 1 – Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISEII**	**ISE III**	**ESE**
K1	Remember	00	00	00	00
K2	Understand	15	15	05	36
K3	Apply	00	00	05	18
K4	Analyze	00	00	00	06
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	**K2**	**K2**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	10	05	00	00
ISE II (15)	10	05	00	00
ISE III (10 Marks)	00	00	05	05
ESE Assessment (60 Marks)	18	18	18	06

ETPE4004: Lab Big Data

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	To understand the execution of Big Data processing pipeline on Cloud	S1
CO2	To implement Big Data code in Apache spark	S2
CO3	To run supervised and unsupervised machine learning algorithm on Large-scale data	S3

List of Experiments: (Perform any 10 Experiments)

Sr. No.	Details
1.	Introduction to Hadoop and Map Reduce
2.	Introduction to Apache Framework
3.	Execution of python statements on Apache Spark
4.	Introducing Spark ML library for supervised learning
5.	Introducing Spark ML library for unsupervised learning
6.	Execution of Linear regression with i) small data & ii) Big data on Apache Spark
7.	Logistic regression to classify Big Data of three class problem
8.	Bayes classifier to classify Big Data of three class problem
9.	Study of probabilistic modelling
10.	Study of Bayesian modelling
11.	Using SVM classifier on Big data classification
12.	Dimensionality reduction using principal component analysis to classify the data
13.	Spark ML library for NLP
14.	A case study involving large amount of data.
15.	A mini-project on big data

Mapping of Course outcome with Program Outcomes

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

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
ISEIII (25 Marks)	05	10	10

Assessment Pattern

Assessment Pattern Level No.	Skill Level	ISEIII
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
S5	Naturalization	00
Total		25

Preparation (S1)	05
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	05
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

ETPE4005: Cloud Computing

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course Outcomes: As an outcome of completing the course, students will able to:

CO1	Analyze the components of cloud computing showing how business agility in an organization can be created.
CO2	Evaluate the deployment of web services from cloud architecture.
CO3	Critique the consistency of services deployed from a cloud architecture
CO4	Critically analyze case studies to derive the best practice model to apply when developing and deploying cloud based applications

Detailed Syllabus:

Unit 1	**Cloud Computing Fundamentals** Cloud Computing definition, Characteristics of Cloud Computing, Components of Cloud Computing. Models in Cloud Computing- a. Deployment models – Private cloud, Public cloud, Hybrid cloud, Community cloud. b. Service models- IaaS, PaaS, SaaS Concept of Tenancy, Multi-Tenancy. Introduction to Grid Computing Applications of cloud computing, Benefits of cloud computing, Limitations of cloud computing.
Unit 2	**Cloud architecture, Services** Cloud Architecture Introduction to Services- a. Infrastructure as a Service b. Platform as a Service c. Software as a Service d. Identity as a Service e. Security as a Service f. Compliance as a Service

Unit 3	**Cloud Infrastructure and Virtualization** Infrastructure – Clients, Security, Network and Services Introduction to Virtualization, Virtualization types a. Server virtualization b. Storage virtualization c. Network virtualization d. Service virtualization, Virtualization management, Virtualization technologies and architectures Introduction to Hypervisors, Types of Hypervisor. Concept of Load balancing
Unit 4	**Security** Cloud Security, Risks, Privacy, Operating system security, Security of virtualization, Data security. Concept of data privacy and data security Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business consideration Infrastructure Security, Network level security, Host level security, Application level security
Unit 5	Cloud implementation and applications Cloud Platforms: Amazon EC2 and S3, Cloudstack, Intercloud, Google App Engine, Open Source cloud Eucalyptus, Open stack, Open Nebulla, etc., Applications.

Recommended Books:

1. Barrie Sosinsky, " Cloud Computing Bible", Wiley
2. Gautham Shroff, "Enterprise Cloud Computing", Cambridge.
3. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions" by John Wiley & Sons, 2011.
4. A.Shrinivasan, J.Suresh, "Cloud Computing: A practical approach for learning and implementation", Pearson.
5. RajkumarBuyya, J.Broberg, A. Goscinski, "Cloud Computing Principles and Paradigms", Wiley.
6. Ronald Krutz,"Cloud Security: Comprehensive guide to Secure Cloud Computing", Wiley Publishing.
7. Anthony T. Velte, "Cloud Computing: Practical Approach", McGraw Hill.
8. Tim Mather, "Cloud Security and Privacy", O'REILLY.

List of Reference Sources for Classes and Assignments:

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition)
2. Enterprise Cloud Computing by GautamShroff,Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Google Apps by Scott Granneman,Pearson
5. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif (SPD,O'REILLY)
6. Cloud Computing : A Practical Approach, Antohy T Velte, et.al McGraw Hill,
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India
8. Stefano Ferrettiet.al.QoS–aware Clouds", 2010 IEEE 3rd International Conference on Cloud Computing
9. Virtualization for Dummies: , Wiley India.

Resources available on e-learning site http://www.e-gecaect.com

Microsoft Technical Journal, Google Cloud Platform resources

Mapping of Course outcome with Program Outcomes :

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1					2			1				3			
CO2		1									3	2			
CO3										3		3			
CO4	3		2		1			3							

3 – High 2 – Medium 1 – Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Recommended Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE -I**	**ISE -II**	**ISE- III**	**ESE**
K1	Remember	05	05	00	10
K2	Understand	10	10	05	20
K3	Apply	00	00	05	25
K4	Analyze	00	00	00	05
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K2	K3
	CO1	CO1,CO2	CO3	CO4
ISE – I (15 Marks)	05	10	00	00
ISE – II (15 Marks)	00	00	10	05
ISE - III (10 Marks)	00	00	05	05
ESE Assessment (60 Marks)	10	20	15	15

ETPE4006: Lab Cloud Computing

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Understand virtualization concept
CO2	Use cloud services provided by Amazon,Google,Azure
CO3	Understand Cloud Services SaaS, PaaS and IaaS
CO4	Use and administrate Open-stack services

List of Experiments: Perform any six experiments.

Sr. No.	Details
1	Installing Ubuntu (server edition) using virtual box, and study virtualization.
2	Installing Openstack cloud: Creating sand box environment using Virtual Box
3	Setting up and using an instance on public IaaS cloud
4	Setting up TeamViewer Software: a) Accessing remote PC on the host PC b) Sharing of files within the desktop shared PC
5	Exploring GitHub to learn features such as a. How to create repositories on GitHub. b. How source code can be uploaded/downloaded from repositories. c. Making code commits in repositories. d. GitHub issue tracking features.
6	Transfer larger files/folders to another computer using cloud storage service
7	Understanding Software as a Service: Sales Force
8	Understanding Platform as a Service: Microsoft Azure
9	Understanding Infrastructure as a Service: Amazon S3
10	Understand Google Apps and create Google forms.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1	1						3		1
CO2			3						2		2	1
CO3			3				1				2	3
CO4			3	2	2			2			3	2

3 – High 2 – Medium 1 - Low

Assessment Table

Assessment Tool	S1	S3	S4	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	05	10	05

Recommended Assessment Pattern :

Assessment Pattern Level No.	**Skill Level**	**ISEIII**
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
S5	Naturalization	00
Total		25

ETPE4011: Mobile Communication

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course Description:

To expose the students to the most recent technological developments in Mobile communication systems.

Course Objectives:

- To deal with the fundamental cellular radio concepts
- To accustom with various multiple access Techniques.
- To know about mobile technologies like GSM and CDMA.
- To get familiar with the higher generation cellular standards and latest Development in mobile applications.
- **Course Outcomes**
- After completing the course, students will be able to:

CO1	Describe the basic cellular concepts in mobile communication.
CO2	Explore the characteristics of different types of Multiple Access Technologies.
CO3	Understand GSM and CDMA Cellular technologies.
CO4	Explore emerging technologies required for future generation mobile systems.

Detailed Syllabus:

Unit 1	**Cellular Concepts:** Frequency reuse, channel assignment strategies, handoff Strategies, Co-channel Interference (CCI), Adjacent Channel Interference (ACI), Interference reduction techniques, improving coverage and capacity in cellular system, Call Setup Processes, SAR value for mobile phone
Unit 2	**Multiple access techniques:** Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access, Spread Spectrum Multiple Access, Space Division Multiple Access.
Unit 3	**GSM & CDMA Overview:** GSM architecture, GSM identifiers ,localization and calling, Introduction to CDMA, CDMA forward & reverse link
Unit 4	**Higher Generation cellular Standards:**3G ,4G, 5G systems.ITU Standards, WCDMA, LTE, MIMO, Introduction of Android O.S.

Text and Reference Books

1. Wireless Communications by Andrea Goldsmith, Cambridge University Press.
2. Modern Wireless Communications by Simon Haykin, Pearson Edition.
3. Wireless Communications: Principles and Practice by Theodore Rappaport,Prentice Hall.
4. Principle and Application of GSM by Vijay K. Garg, J.E.Wilkes, Pearson Education.
5. IS-95 CDMA & CDMA 2000 by Vijay K. Garg, Pearson Education,

William C.Y.Lee, Mobile Cellular Telecommunications Analog and Digital Systems, II Ed

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1						3		1				2			
CO2					1	3								2	
CO3			2	2	2	3						1		2	
CO4				3	2	3									

3 – High 2 – Medium 1 - Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**ESE**
K1	Remember	05	00	00	12
K2	Understand	10	05	05	26
K3	Apply	00	10	05	22
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	**K2**	**K2**	**K2**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I	08	07	00	00
ISE II	00	08	07	00
ISE III	00	05	05	00
ESE Assessment (60 Marks)	15	12	15	18

ETPE4012: Lab Mobile Communication

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Acquire knowledge of GSM AT commands for different applications
CO2	Understand the characteristics and limitations of mobile hardware devices.
CO3	To get familiar with future generation mobile systems.
CO4	Use contemporary development environment and languages (java, Android etc.) to develop mobile applications.

List of Experiments

Sr. No.	Details
1	Generation of following waveform usingMatlab code. ● Direct sequence spread spectrum (DSSS) modulation & demodulation ● TDM modulation and demodulation.
2	Understanding GSM handset for various signaling and fault insertion techniques
3	Working with various GSM- AT Commands.
4	Demonstration of DS-SS modulation/Demodulation Process on CDMA trainer.
5	To get familiar with front panel of 3G mobile phone trainer and To observe test point voltages of 3G mobile phone trainer
6	Understanding smart phone technology.
7	Development of any one android based application.
8	To study and observe system blocks/ sections in GSM handset like: clock, SIM card, charging, LCD module, Keyboard,etc

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1				3	2									2	
CO2				2	2										
CO3				3	3	2									
CO4				3	3	2	3					2		3	

3 – High 2 – Medium 1 – Low

Assessment Pattern

Preparation (S1)	04
Conduct of Experiment (S2)	04
Observation and Analysis of Results (S3)	08
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	06
Total	**25**

ETPE4013: Radar and Satellite Communication

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course covers fundamental principles of Radar. It deals with various types of Radars and their applications. Exposure to Satellite communication, basic terms related to satellite, transponder, up link and down link budgets and also given accessing methods.

Course Objectives:

- To introduce the fundamental concepts of Radar &Satellite Communication.
- To explain different types of Radar systems.
- To impart knowledge of satellite segments, orbits, link budgets.
- To give exposure to various methods of satellite access.

Course Outcomes

After completing the course, students will able to:

CO1	Understand basics of Radar Communication and Satellite Communication	K2
CO2	Explain operations of various types of Radar Systems	K2
CO3	Interpret various access techniques for satellite applications	K2
CO4	Describe design of satellite communication link sand tracking Radar systems	K2

Detailed Syllabus:

Unit1	**Fundamentals of Radar** Introduction to Radars, Radar frequencies, Principles, Applications, Types & Displays .Pulse Radar: Block Diagram and Operation. Radar Range Equation, Range Performance of Radars, Minimum Detectable Signal, Noise Effects, Pulse Repetition Frequency and Range Ambiguities.
Unit2	**CW and FM-CW Radar** Doppler Effect, Continuous wave Radar Principle, Block diagram, Bank of filters, Isolation between transmitter and receiver, Radial Velocity, Application. Frequency Modulated Continuous wave Radars Principle, Block diagram, Multiple CW Radar. Airborne Radar, Altimeter. MTI and Pulse Doppler Radar, Delay line Cancellers, coherent and non-coherent MTI, Pulse Doppler Radar
Unit3	**Satellite Communication, satellite segment & Space Link** Basic concepts of Satellite Communications, Satellite Orbits, Space Segment Introduction, TT&C Subsystem, Transponders, Transmit-Receive Earth Stations. Space Link: Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, Link –Power Budget Equation, System Noise, Carrier to Noise Ratio, The Uplink, Saturation flux density, Input back-off, Downlink, Output back-off, Combined Uplink Uplink and Downlink C/N Ratio
Unit4	**Introduction to Satellite Access** Introduction, Single Access, Preassigned FDMA, Demand Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand Assigned TDMA, Satellite Switched TDMA, Code Division Multiple Access.

Text and Reference Books:

1. MerrillI. Skolnik,"Introduction to Radar Systems", McGraw-Hill International.
2. Bassem R.Mahafza,"Radar SignalAnalysis&ProcessingUsingMATLAB",aChapman & Hall Book, Special Indian Edition.
3. Dennis Roddy,"Satellite Communications", Tata Mc Graw Hill Publications,fourth edition.
4. RobertM.Gagliardi,"SatelliteCommunication", CBSPublishers & Distributors.

Anil K. Maini, Varsha Agarwal, "Satellite Technology, Principles and Applications", Wiley publications, Second Edition

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2									1			2	2	
CO2	2									1			2	2	
CO3	2		1			1	1			1			2	2	
CO4	3	2	2			3	2			2			1	2	

3 – High **2 – Medium** **1 – Low**

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISEI**	**ISEII**	**ISEIII**	**End Semester Examination**
K1	Remember	05	05	00	10
K2	Understand	10	10	05	45
K3	Apply	00	00	05	05
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
TotalMarks100		15	15	10	60

Assessment table:

Assessment Tool	**K2**	**K2**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISEI (15Marks)	05	10	00	00
ISE II(15Marks)	05	10	00	00
ISEIII(10 Marks)	00	05	05	00
ESE Assessment(60Marks)	20	20	15	05

ETPE4014: Lab Radar and Satellite Communication

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Understand fundamentals of Radar communication, satellite communication, satellite transponders and satellite accesses.	S2
CO2	Measure and analyze different parameters of Radar Systems	S3
CO3	Measure and analyze different parameters of Satellite links.	S3

List of Experiments:

Sr. No.	Details
1.	Understand and setup basic Radar System
2.	Measure Range of pulse radar for different values of radar peak power.
3.	MeasureSignaltoNoiseRatioagainsttargetdetectionrangefordifferentvaluesoftarget Radar cross section.
4	Object counting with the help of Radar.
5.	Understanding satellite communication frequency bands and orbits.
6.	To write a program to plot the degradation in downlink C/I.
7.	Time domain presentation of Echo wave pattern
8.	Understanding the antenna plane of transmission & reception for echo signal
9.	Antenna coupling & beam estimation of FMCW Radar
10	Time domain presentation of Echo wave pattern & comparison with and without target
11	Understanding the FFT ,with and without target
12	DOPPLER Shift analysis and measurement using DSO
13	Characterization of σcs for different target material& Comparison
15	MATLAB based RADAR signal processing.

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1-Low

Assessment Table :

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
ISEIII(25Marks)	9	8	8

ETPE4015: Optical Wireless Communication beyond 5G network

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course deals with the basics of optical wireless communication uses optical carrier in the near infrared (IR) and visible bands and is considered a viable solution for achieving high speed and large capacity communication link. The students will learn characteristics of the channel response for indoor, outdoor and underwater to enable efficient design of OWC system which is used to analyze and offer solutions to counter the channel distortions.

Course Objectives:

- To introduce the 5G technology and the research areas in the advanced optical wireless communication technology.
- Be familiar with terminologies such as CSK, O-OFDM, NOMA etc.,
- To help in identifying the opportunities to flourish the knowledge and pursue research in this area.
- To improve the research abilities of the students/Research Scholars in the advanced wireless communication technology.
- Developing an analytical capability for solving various problems of next generation optical wireless communications.

Course Outcomes:

After completing the course, students will able to:

CO1	Apply the knowledge of basic concepts of optical wireless communication.
CO2	Understand roadmap for beyond 5G technology in the advanced optical wireless communication.
CO3	Design basic optical Indoor-outdoor OWC Link Performance.
CO4	Understand use of modern tools for simulation of modulation.

Detailed Syllabus:

Unit 1	**Introduction: Optical Wireless Communication Systems** Existing wireless Access Schemes, OWC/Radio Comparison, Potential OWC Application Areas .Introduction: Optical Sources and Detectors: LEDs, Lasers, PIN, APD, Photo detector**.**5G wireless trends and technologies, Comparison 5G vs. optical Fiber.
Unit 2	**Channel modelling**: **Indoor OWC Channel Modeling:** LOS Propagation Model, Non-LOS Propagation Model, Interference from other Light sources **Outdoor OWC Channel Modeling:** Atmospheric Channel Loss, Beam Divergence, Pointing Loss, Different Atmospheric Turbulence Models. **Underwater OWC Channel Modeling:** Absorption, scattering, Turbulence, Multipath interference, Physical obstruction, and Background noise
Unit 3	**Modulation Schemes:** Digital Baseband Modulation Techniques PAM, PPM, PIM etc., Multi-carrier Modulation (OFDM) for OWC, Color Shift Keying, NOMA ,coherent OWC systems **System Performance Analysis :Indoor OWC links:** Effect of Ambient Light Sources, Multipath Propagation. **Outdoor OWC links:** FSO Link Performance under the Effect of Atmospheric Turbulence-Induced Penalty and mitigation strategies.
Unit 4	O-OFDM and CSK Modulation Schemes, Challenges in VLC , WiFi /LiFi Co-existence(hybrid network LiFi and WiFi),V2V Communications

Text and References Books:

- "Advanced Optical Wireless Communication Systems" Shlomi Arnon, John Barry, George Karagiannidis, Robert Schober, and Murat Uysal
- Optical Wireless Communications System and Channel Modelling Z. Ghassemlooy W. Popoola S. Rajbhandari
- G. Keiser, Optical Fiber Communications (4/e), TMH, 2008

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	1	1											1	2	
CO2	1	1	2		1								1	2	
CO3	3	2							1	1			1	2	
CO4	1	2	3						1	2	2		1	2	

3 – High 2 – Medium 1 - Low

Assessment:

ISE I	Shall be on the basis of Class test
ISE II	Shall be on the basis of Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**ESE**
K1	Remember	00	00	00	00
K2	Understand	15	15	05	42
K3	Apply	00	00	05	18
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	**K3**	**K2**	**K3**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	10	05	00	00
ISE I (15 Marks)	10	05	00	00
ISE III (10 Marks)	00	00	05	05
ESE Assessment (60 Marks)	12	18	12	18

ETPE4016: Lab Optical Wireless Communication beyond 5G network

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Plot the characteristics of optical devices.
CO2	Organize various components of optical wireless communication and establish /set up Transmission-reception link.
CO3	Understand use of modern tools to perform optical wireless communication related measurements.

List of Experiments: (Minimum eight)

1.	Draw the characteristics of optical sources and detectors
2.	Establish an optical wireless communication link in Optisystem.
3.	Study the potential of an optical wireless communication and make a comparison with 5G & 6G Wi-Fi (RF) technologies.
4.	Simulation analysis of underwater wireless optical communication.
5.	Simulation of Channel Estimation, Synchronization & Equalization techniques
6.	Simulation of indoor visible light communication system.
7.	Demonstrations of High-Capacity THz-Wireless Transmission Systems for Beyond 5G
8.	Design and Implementation of Color-Shift Keying for Visible Light Communications
9.	To determine the free space loss and the power received using Matlab program.
10.	Modelling and characterization of short range underwater OWC channels.
11.	Simulation of LOS propagation model environment using Optisystem.
12.	VLC transmitter and receiver using Optisystem.(LOS and NON LOS propagation model)

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO1	PO 2	PO 3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO1 2	PSO 1	PS0 2	PS0 3
CO1	1	1		2									1	2	
CO2	1	1	1	1									1	2	
CO3	1	1			3								1	2	

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
ISE III (25 Marks)	5	10	10

Assessment Pattern:

Assessment Pattern Level No.	Skill Level	ISEIII
S1	Imitation	5
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
S5	Naturalization	00

Preparation (S1)	5
Conduct of Experiment (S2)	5
Observation and Analysis of Results (S3)	5
Record (S2)	5
Mini-Project / Presentation/ Viva-Voce (S3)	5
Total	**25**

ETPE 4021: Digital VLSI

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description:

This course deals with the basics of MOS devices, fundamentals and concepts of digital VLSI design. An exposure will be given to static and dynamic characteristics of CMOS Inverter, CMOS Static and Dynamic Design.

Course Objectives:

1. To understand theory and to learn aspects of transistor level design.
2. It addresses issues related to size, speed and power consumption.

Course Outcomes

After completing the course, students will able to:

CO1	Understand design metrics, devices and interconnect parameters with wire models and impact of technology scaling.
CO2	Summarize the performance and behavior of MOS devices, CMOS Inverter.
CO3	Evaluate the static and dynamic performance of CMOS design to design combinational circuits.
CO4	Design and draw stick diagrams, layouts for CMOS gates and adders.

Detailed Syllabus:

Unit 1	**Introduction** Basic MOS structure and its static behavior, Quality metrics of digital design, Devices: Diode and MOSFET; Stick diagram and Layout, Interconnect Parameters, Electricals wire models
Unit 2	**The CMOS Inverter** The static CMOS inverter, Static and Dynamic Behavior, Power, Energy and Energy Delay of CMOS Inverter, Technology scaling and its impact on the inverter metrics
Unit 3	**Static CMOS Design** Complementary CMOS, Ratioed Logic, Pass-Transistor Logic, Transmission gate logic
Unit 4	**Dynamic CMOS Design** Dynamic Logic: Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates, Perspectives

Text and Reference Books:

1. Digital integrated circuits: a design perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, PHI
2. CMOS VLSI Design, Weste and Harris, Addison Wesley.
3. Modern VLSI Design - System-on-chip Design, Wayne Wolf, Prentice Hall India/Pearson Education
4. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang and Yusuf Lablebici, Tata McGraw-Hill Edition.

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PS O2	PS O3
CO1	1												2		1
CO2	1	2	2	2									2		1
CO3	1	2	2	2		1			1	1		1	2		1
CO4		2	1	2		1			1	1		2	2		1

3 – High 2 – Medium 1 – Low

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	00	00	00	00
K2	Understand	15	15	05	42
K3	Apply	00	00	05	18
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	**K2**	**K2**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	10	05	00	00
ISE II (15 Marks)	00	10	05	00
ISE III (10 Marks)	00	00	05	05
ESE Assessment (60 Marks)	12	12	18	18

ETPE 4022: Lab Digital VLSI

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	To understand the fundamentals of CMOS Technology in Digital Domain	S1
CO2	Design digital gates and adders with given specifications and design constraints.	S2
CO3	To demonstrate the ability for using backend tools in IC technology	S3

List of Experiments:

Sr. No.	Details
1.	Introduction to Hiper Silicon (tanner) / Micro-wind software
2.	CMOS designing using Hiper Silicon(tanner) / Micro-wind software
3.	To study the behavior of MOS transistor by analyzing ID v/s VDS curve and ID v/s VGS curve
4.	Design and Simulation of CMOS Inverter
5.	Design and Simulation of CMOS NOR Gate
6.	Design and Simulation of CMOS NAND Gate
7.	Design and Simulation of CMOS AND and OR Gate
8.	Design and Simulation of CMOS Ex-OR and Ex-NOR Gate
9.	Design and Simulation of Half Adder
10.	Design and Simulation of Full Adder

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3
CO1				2	1								2		1
CO2				2	2								2		1
CO3				2	2								2		1

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
ISEIII (25 Marks)	05	10	10

Assessment Pattern:

Assessment Pattern Level No.	Skill Level	ISEIII
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
55	Naturalization	00
Total		25

Preparation (S1)	05
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	05
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

ETPE4023: Digital Image Processing

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course covers representation of image in matrix form. Various operations carried out on image to boost the quality of image or to compress the image are covered. Algorithms based on morphology, segmentation lead to important applications. Course covers all the spatial and frequency domain techniques for image enhancement. This also exposes the representation and classification of images.

Course Objectives:

- To explain image matrix formation
- To impart knowledge of image enhancement techniques
- To elaborate various morphological processes
- To expose to segmentation techniques
- To introduce applications of image processing

Course Outcomes:

After completing the course, students will able to:

CO1	Understand digital representation of image
CO2	Learn the image processing algorithms for image enhancement and restoration
CO3	Apply image processing techniques to real world problems
CO4	Conduct independent study and analysis of image processing problems and techniques

Detailed Syllabus:

Unit 1	Fundamental of Image Processing: Image Sensing and Acquisition, Image Sampling and Quantization, Digital Image Representation, Basic Relationship between Pixels, Linear and Nonlinear Operations, **Image formats,** Intensity transformation, Image Enhancement in Spatial Domain **Image Registration, Geometric Transformations**
Unit 2	2D Fourier Transforms, Frequency Domain Filtering, Image degradation/Restoration: Model, Estimating Degradation Function, different noise models, Restoration in presence of noise, Periodic noise reduction by frequency domain filtering Inverse Filtering, Wiener Filtering, Constrained Least Square Filtering, Geometric Mean Filtering Color Image Processing
Unit 3	**Image Compression:** Fundamentals, Compression Models, Entropy Computation, Loss less and Lossy Compression, Image Compression Standards **Morphology:** Dilation, Erosion, Opening and Closing, Basic Morphological Algorithms, Binary and Gray Scale Morphology
Unit 4	**Image Segmentation:** Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Use of Motion in Segmentation **Representation and Description:** Representation Schemes, Boundary Descriptors, Regional Descriptions, Relational Descriptors

Text and Reference Books:

- Rafel Gonzales and Richard Woods, Digital Image Processing, ThirdEdition, Pearson Education
- A. K. Jain, Fundamentals of Digital Image Processing, PHI

Rafel Gonzales and Richard Woods, Digital Image Processing with MATLAB, Pearson Education

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO	PSO2	PSO 3
CO1	2	2													1
CO2		2	2												2
CO3			2							3	3	3			3
CO4		1	2								3	3			3

1 – Low 2 – Medium 3 - High

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	05	00	00	10
K2	Understand	10	10	05	35
K3	Apply	00	05	05	15
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	**K1**	**K2**	**K3**	**K4**
	CO1	**CO2**	**CO 3**	**CO4**
ISE I (15 Marks)	05	00	00	00
ISE II (15 Marks)	00	10	05	00
ISE III (10 Marks)	00	05	05	00
ESE Assessment (50 Marks)	10	35	15	00

ETPE4024: Lab Digital Image Processing

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Demonstrate image information
CO2	Manipulate various image operations
CO3	Manipulate image using various filters
CO4	Differentiate between spatial and frequency domain operation

List of Experiments

Sr. No.	Details
1	Study image information and various image formats
2	Write programs to perform arithmetic and logical operations on image
3	Write programs to perform geometric operations on image
4	Implement various Image enhancement algorithms
5	Implement various spatial domain filters on images
6	Implement various frequency domain filters on images
7	Perform different morphological operations on image
8	Implement image segmentation using different edge detection techniques
9	Implement image segmentation using thresholding for different images
10	Implement region based image segmentation for multiple applications

Mapping of Course outcome with Program Outcomes

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

1 – Low 2–Medium 3 - High

Assessment Table :

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
ISEIII (25 Marks)	05	10	10

Assessment Pattern:

Assessment Pattern Level No.	**Skill Level**	**ISEIII**
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
S5	Naturalization	00
Total		25

Preparation (S1)	05
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	05
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

ETPE4025: Robotics

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: The course gives exposure to fundamentals of Robotics. Robotics has become major field or future industries. The course covers the basic understanding of Kinematics and Dynamics and various controls involved in robotics. This also includes exposure to applications of Robotics and Robot vision.

Course objectives: The course has the following objectives:

- To develop understanding Robotics components
- To know the classification of Robots
- To impart knowledge of kinematics and dynamics
- To expose the students to Robot control and applications

Course Outcomes: After completing the course, the students will able to:

CO1	Learn classification and mechanics and controls involved in Robot	**K1**
CO2	Understand Robotics, kinematics and dynamics	**K2**
CO3	Explore role of robotics in modern era	**K3**
CO4	Study Robotic systems and applications	**K2**

Detailed Syllabus:

Unit	Content
Unit-I	**Introduction to Robotics and Components** Automation and Robotics, Definition, Basic Structure of Robots, Classification of Robots based on coordinate system, Present trends and future trends in robotics, Overview of robot subsystems. Manipulator, Controller, Power conversion unit etc., Specifications of robot.
Unit-II	**Kinematics & Dynamics** Rigid body Kinematics, Inverse Kinematics, Rotation matrix, Homogenous transformation matrix, Denavit - Hardenberg convention, Euler angles, RPY representation, Direct and inverse Kinematics for industrial robots, Lagrangian Dynamics, link inertia tensor and manipulator inertia tensor, Newton-Euler Dynamics of Robot
Unit-III	**Robot Control** Control approaches: oscillatory based time varying control law, control law based on vector field orientation approach. Advanced strategies of control: conventional aerial vehicle, Bidirectional X4-flyer.
Unit-IV	**Applications** Applications of Fuzzy Logic and Neural network in Robot Control, Neural controllers, Implementation of Fuzzy controllers: Trajectory tracking controller. Applications of Robotic system: complex control system, Human Robot Interaction: Architecture.AI systems

Text and Reference Books:

1. Fundamentals of Robotics: Analysis and Control – *Robert J Schilling,* PHI, New Delhi
2. Robotic Engineering – *Klafter, Thomas, Negin,* PHI, New Delhi
3. Robotics, Fu, Gonzales and Lee, , McGraw Hill
4. Introduction to Robotics, J.J, Craig, , Pearson Education
5. Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari
6. Robotics And Automation Handbook, Thomas R. Kurfess, CRC Press, 2004, ISBN 0-8493-1804-1

Mapping of course outcome with program outcomes:

Program outcome / Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	**3**												**3**		
CO2		**2**							**2**				**3**		
CO3						**2**			**2**		**2**		**3**		
CO4			**3**		**2**	**2**			**2**				**3**		

3-High **2-Medium** **1-Low**

Assessment:

ISE I	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects
ISE II	Shall be based on Class test
ISE III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	5	5	00	06
K2	Understand	10	10	00	42
K3	Apply	00	00	10	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks (100)		15	15	10	60

Assessment Table:

Assessment Tool	K1	K2	K3	K2
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 marks)	05	10	--	--
ISE II (15 marks)	04	06	--	05
ISE III (10 marks)	--	05	05	--
ESE Assessment (60 marks)	06	24	12	18

ETPE4026: Lab Robotics

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Explore controllers, motors, actuators, encoders, sensors used in robots.
CO2	Develop an understanding of economic issues related to industrial Robotic and automation systems.
CO3	Participate in a group atmosphere for the defining, planning, and execution of an open ended robotic system.

List of Experiments :

Sr. No.	Details
1	Introduction of Robotic system, various configurations and DOF calculations
2	Basic robot Joints and its simulation using high end computer software
3	Direct kinematics for open/closed loop configurations analytically/simulation/coding
4	Inverse kinematics for open/closed loop configurations analytically/simulation/coding
5	Coding/simulation of direct kinematics for open/closed loop configurations along with work space generation using high end software
6	Formulation of DH parameters of robot configuration and its simulation using open source software
7	Simulation/ performance of a trajectory planning of a robot
8	Application of various robotic sensors along with specifications and their applications area
	OPEN ENDED PROBLEM 1. Design of robot for a given degree of freedom and required pay load capacity 2. Static force analysis of any robot or robotic arm configuration under consideration 3. Trajectory planning for a robot for a given industrial requirement MAJOR EQUIPMENT - Robot kits - MATLAB/ High end Simulation software for mechanisms/robots

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1				3	2	1						3	2		
CO2		1		3	3							2	2		
CO3				3							2	1	2		
CO4				3	2	1						3	2		

3 – High 2 – Medium 1 - Low

Assessment Table

Assessment Tool	S1	S3	S4	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	05	10	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**ISE III**
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
S5	Naturalization	00

ETPE4027: Automotive Electronics

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course Objectives:

- To understand the concepts of Automotive Electronics and evolution
- To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
- To understand the role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.
- To describe various communication systems, wired and wireless protocols used in vehicle networking.
- To understand Safety standards, advances in autonomous vehicles.
- To understand vehicle on board and off board diagnostics.

Course Outcomes:

After completing the course, students will able to:

CO1	Identify automotive components and subsystems
CO2	Interface automotive sensors and actuators with microcontrollers
CO3	Understand the control algorithms
CO4	Understand Electronic management in a vehicle

Detailed Syllabus:

Unit 1	**Automotive Fundamentals:** The engine components, Drive train, Starting & charging systems, operations, Ignition system, Suspension systems, brakes, ABS Steering system.
Unit 2	**Automotive Sensors:** Basic sensor arrangement, Temperature sensor-gas sensor, knock sensor, pressure sensor, flow sensor, torque sensor, crash sensor, Speed sensor and acceleration sensor, micro sensor, Oxygen Sensor, Cranking Sensor, Position Sensors, Engine cooling water temperature Sensor, Engine oil pressure Sensor, Fuel metering, Vehicle speed sensor and detonation sensor, parking sensors, interface with the controllers and processors and applications in automobiles.
Unit 3	**Electronic management:** Electronic management of chassis systems, Vehicle motion control, anti - lock braking system, Tyre pressure monitoring system, Collision avoidance system, Traction control system, Active suspension system Keyless entry system and Electronic power steering system, V2X communication protocols systems, Fault finding and diagnostics system.
Unit 4	**Vehicle Intelligence:** Introduction, basic structure, vision based autonomous road vehicles, architecture for dynamic vision system features, applications, A visual control system using image processing and fuzzy theory, An application of mobile robot vision to a vehicle information system, object detection, collision warning and Avoidance system, Tyre pressure warning system, Infotainment systems .

Text books:

1. Williams. B. Ribbens: "Understanding Automotive Electronics", 6th Edition, Elsevier Science, Newnes Publication, 2003.
2. Robert Bosch: "Automotive Electronics Handbook", John Wiley and Sons, 2004.

Reference books:

1. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. James D. Halderman: "Automotive Electricity and Electronics", PHI Publication.
3. Terence Rybak& Mark Stefika: "Automotive Electromagnetic Compatibility (EMC)", Springer, 2004.
4. Allan Bonnick: "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science, 2001.
5. UweKieneke and Lars Nielsen: "Automotive Control Systems: Engine, Driveline and Vehicle", 2nd Edition, Springer Verlag, 2005.
6. David Alciatore& Michael Histand: "Introduction to Mechatronics and Measurement Systems (SIE)", TMH, 2007.
7. Iqbal Husain: "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
8. Tom Denton: "Advanced Automotive Diagnosis", 2nd Edition, Elsevier, 2006

Assessment:

ISE I:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	1	1	1		2								1		
CO2	2	2	2		2					2		2	2		
CO3			1		1					2		1	2		
CO4			2		2					2		1	2		

3 – High 2 – Medium 1 – Low

Recommended Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	05	05	00	10
K2	Understand	10	10	00	25
K3	Apply	00	00	10	25
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K2	K2
	CO1	CO2	CO3	CO4
ISE I (15 Marks)	05	10	00	00
ISE II (15 Marks)	00	05	05	05
ISE III (10 Marks)	00	00	05	05
ESE Assessment (60 Marks)	10	20	10	20

ETPE4028: Lab Automotive Electronics

Teaching Scheme		Evaluation Scheme	
Practical	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry
CO2	Interface automotive sensors and actuators with microcontrollers
CO3	Develop, simulate and integrate control algorithms for ECUs with hardware

List of Experiments:

Sr. No.	Details
1	Demonstrate Electronics Ignition system- Suspension systems-brakes -ABS - Steering system.
2	Analysis of brakes -ABS - Steering system.
3	Understanding smart sensor-operation, types, characteristics, advantages and their applications.
4	Applications of Microprocessor and Microcontrollers in automobiles
5	Electronic management of chassis systems and tyre pressure monitoring system,
6	Fault identification systems
7	Understanding Collision avoidance system, Traction control system, Active suspension system
8	Study of Keyless entry system and Electronic power steering system
9	Case Study: Two wheeler
10	Case Study: Four wheeler

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1 - Low

Approved in XXVIIth Academic Council
Dated: 23rd Nov 2023

Assessment Table:

Assessment Tool	S1	S3	S4
	CO1	CO2	CO3
ISEIII (25 Marks)	05	10	10

Recommended Assessment Pattern :

Assessment Pattern Level No.	**Skill Level**	**ISEIII**
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
55	Naturalization	00
Total		25