Shri Balasaheb Mane ShikshanPrasarak Mandal's,
ASHOKRAO MANE GROUP OF INSTITUTIONS
NH – 4, VatharTarfVadgaon, Tal: -Hatkanangale, Dist: - Kolhapur-416112
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An Autonomous Institute

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Curriculum Structure and Evaluation Scheme for M. Tech. in Electronics and Telecommunication Engineering and Multidisciplinary Minor

(To be implemented for 2025-2027 Batch)

Head of Department	Dean Academics	Director	Campus Director
Dr. D. J. Pawar	Dr. S. S. Patil	Dr. S. R. Chougule	Prof. P. B. Ghewari

SHRI BALASAHEB MANE SHIKSHAN PRASARAK MANDAL'S ★ ASHOKRAO MANE GROUP OF INSTITUTIONS ★ Vathar Tarf Vadgaon ★ Tal. Hatkanangale Dist. Kolhapur

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ABBREVIATIONS

- **L:** Lecture
- **T:** Tutorial
- **P:** Practical
- **ISE-I-** In Semester Evaluation I
- **ISE-II-** In Semester Evaluation II
- **MSE:** Mid Semester Exam
- **ESE:** End Semester Exam
- **PCC**: Program Core Course
- **PEC**: Program Elective Course
- **OE**: Open Elective Course
- **AEC:** Ability Enhancement Course
- **ELC:** Experiential Learning Course
- **AC:** Audit Course
- **RM:** Research Methodology

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Department: Department of Electronics and Telecommunication Engineering
Semester: I

Type of Course	Course Code	Course Name	Teaching Scheme				Evaluation Scheme			
			L	T	P	Cr	Components	Max	Min. for Passing	
PCC	P25ET101	Probability Theory and Random Processes	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
PCC	P25ET102	Advanced Digital Signal Processing	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
PCC	P25ET103	Advanced Digital Communication	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
PEC	P25ET104	Program Elective-I	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
RM	P25ET105	Research Methodology and IPR	2	-	-	2	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
ELC	P25ET106	Seminar	-	-	2	1	ISE	50		40
							ESE(OE)	50	20	
PCC	P25ET107	PG Lab-I	-	-	4	2	ISE	50		40
							ESE(POE)	50	20	
AC	P25ET108	Yoga and Meditation	1	-	-	-	-	-	-	
	Total		**15**	**03**	**06**	**20**		**700**		
Total Contact Hours- 24							**Total Credits- 20**			

Department: Department of Electronics and Telecommunication Engineering
Semester: II

Type of Course	Course Code	Course Name	Teaching Scheme				Evaluation Scheme			
			L	T	P	Cr	Components	Max	Min. for Passing	
PCC	P25ET201	Advanced Embedded System	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
PCC	P25ET202	Image Processing and Computer Vision	3	1	-	4	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
PCC	P25ET203	Network Security and Cryptography	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
PEC	P25ET204	Program Elective-II	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
OE	P25ET205	Open Elective-I	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
VEC	P25ET206	Technologies for Industrial Evolution	2	-	-	2	ISE-I	25	20	20
							ISE-II	25		
ELC	P25ET207	Mini Project	-	-	2	1	ISE-I	25		40
							ISE-II	25		
							ESE (POE)	50	20	
PCC	P25ET208	PG Lab-II	-	-	4	2	ISE	50		40
							ESE (POE)	50	20	
ELC	P25ET209	Internship/Field Training#	-	-	-	-	Will be Evaluated in Sem-III	-	-	
	Total		**17**	**02**	**06**	**22**		**750**		
Total Contact Hours- 25							**Total Credits- 22**			

It is required to do Four weeks domain specific industrial internship after completing first year of the program evaluated in Semester-III.

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Department: Department of Electronics and Telecommunication Engineering
Semester: III

Type of Course	Course Code	Course Name	Teaching Scheme				Evaluation Scheme			
			L	T	P	Cr	Components	Max	Min. for Passing	
OE	P25ET301	Open Elective-II$	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
MDM	P25ET302	Multi-Disciplinary Minor$	3	-	-	3	ISE-I	10		40
							MSE	30		
							ISE-II	10		
							ESE	50	20	
ELC	P25ET303	Dissertation Phase- I*	-	-	20	10	ISE-I	25		40
							ISE-II	25		
							ESE(POE)	50	20	
ELC	P25ET209	Internship/Field Training Evaluation#	-	-	-	2	ISE	50	20	-
	Total		**06**	**00**	**20**	**18**		**350**		
Total Contact Hours- 26 Total Credits- 18										

$ It is mandatory to opt these courses certification from SWAYAM/NPTEL, MOOC platform.
* It is required to complete 30% work of Dissertation.
# It is required to do Four weeks domain specific industrial internship after completing first year of the program evaluated in Semester-III

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Department: Department of Electronics and Telecommunication Engineering
Semester: IV

Type of Course	Course Code	Course Name	Teaching Scheme				Evaluation Scheme			
			L	T	P	Cr	Components	Max	Min. for Passing	
ELC	P25ET401	Dissertation Phase- II*	-	-	40	20	ISE-I	50	40	80
							ISE-II	50		
							ESE(POE)	100	40	
	Total		-	-	40	20		200		
Total Contact Hours- 40							**Total Credits- 20**			

* It is required to publish/present two papers out of which at least one paper should be in a SCI/ SCIE/ SCOPUS/ Web of Science/ Peer-Reviewed Journal before Thesis Submission.

Department: Department of Electronics and Telecommunication Engineering

Exit Courses after Semester– II - P.G. Diploma

Type of Course	Course Code	Course Name	Teaching Scheme				Evaluation Scheme		
			L	T	P	Cr	Components	Max	Min. for Passing
ELC	P25ET209	Internship/Field Training Evaluation#	-	-	-	2	ISE	50	40
							ESE	50	
AEC	P25ET210	Employability Skill Development*	4		-	4	ISE	50	40
							ESE	50	
	Total		**04**	**00**	**00**	**6**		**200**	
Total Contact Hours- 04 Total Credits- 06									

*It is mandatory to opt this course certification from SWAYAM/NPTEL MOOC platform

Four weeks domain specific industrial internship after successfully completing first year of the program.

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PROGRAM ELECTIVE

(Students have to select any one Program Elective course out of 03, for each applicable semester, of their interest, offered by the PG Program from the table below)

Program Elective – I			
Sr. No.	**Course Code**	**Course Name**	**Semester**
1	P25ET104A	RF and Microwave Circuit Design	I
2	P25ET104B	VLSI architectures for Signal Processing	
3	P25ET104C	Soft Computing	

Program Elective – II			
Sr. No.	**Course Code**	**Course Name**	**Semester**
1	P25ET204A	5G and Edge Computing	II
2	P25ET204B	Mixed Signal and RF Circuit Design	
3	P25ET204C	Artificial Intelligence and Machine Learning	

MULTIDISCIPLINARY MINOR (MDM)

(Students have to select any one course of their interest (other than a courses offered by their program) for the award of Minor Degree from the table below)

Sr. No.	**Course Code**	**Course Name (MDM)**	**Semester**	**Offered by the Department**
1	P25ET302	IoT and its Applications	III	Electronics & Telecommunication Engineering
2	P25CS302	Artificial Intelligence & Machine Learning	III	Computer Science and Engineering
3	P25MD302	Introduction to Industry 4.0 and Industrial Internet of Things	III	Mechanical Engineering
4	P25MP302	Product Life Cycle Management	III	Mechanical Engineering
5	P25CM302	Principles of Construction Management	III	Civil Engineering

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OPEN ELECTIVE COURSES

(Students have to select any one Open Elective course, for each applicable semester, of their interest from the basket below.)

Open Elective – I Semester II			Open Elective – II Semester III		
Sr.	**Course Code**	**Course Name (OE)**	**Sr.**	**Course Code**	**Course Name (OE)**
1	P25ET205A	Environment and Development	1	P25ET301A	Labour Welfare and Industrial Relations
2	P25ET205B	Engineering Economics	2	P25ET301B	Sustainable Technology
3	P25ET205C	Project Management	3	P25ET301C	Entrepreneurship Development
4	P25ET205D	Healthcare Engineering	4	P25ET301D	Industrial Automation

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SEMESTER-I

Title of the Course Name: Probability Theory and Random Processes **Course Code:**P25ET101	**L**	**T**	**P**	**Credits**
	3	1	--	4

Pre-Requisite: Basic knowledge of probability theory, Signals and Systems, and Linear Algebra

Course Objectives: The course aims:

1. To introduce fundamental concepts of probability theory and random variables
2. To develop understanding of random processes, their classifications, statistical properties, and real-world examples.
3. To analyze correlation functions and power spectral densities,
4. To model and simulate stochastic systems, including Markov and Poisson processes

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

CO	Course Outcomes	Bloom's Level
CO1	Apply probability theory and compute distributions for random variables in single and joint scenarios.	A
CO2	Analyze statistical properties of random processes and determine their stationarity and ergodicity.	AN
CO3	Evaluate autocorrelation, power spectral density, and system response to stochastic inputs.	E
CO4	Simulate and interpret random processes and Markov/Poisson models using computational tools.	A

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Basics of Probability and Random Variables:** Basic probability theory, Conditional probability, Bayes' theorem, Random variables: discrete and continuous, Probability distribution and density functions, Joint distributions and functions of random variables	**6**
2	**Introduction to Random Processes:** Definition and classification, Stationarity and ergodicity, Mean, autocorrelation, and autocovariance functions, Gaussian and Poisson processes, Properties and examples of random processes	**6**
3	**Correlation Functions and Spectral Density:** Autocorrelation and cross-correlation, Properties of correlation functions, Power spectral density (PSD), Cross-power spectral density, Wiener-Khinchin theorem, Parseval's theorem	**6**
4	**Linear Systems with Random Inputs:** System response to random inputs, Linear time-invariant (LTI) systems, Output mean and autocorrelation, Transmission of PSD through LTI systems, Examples of filtering random processes	**6**
5	**Markov and Poisson Processes:** Markov chains: definitions and transition probabilities, State diagrams and classification of states, Stationary distributions, Poisson process: definition and properties, Applications in queuing and reliability systems	**6**
6	**Applications and Simulation of Random Processes:** Stochastic modeling in communications and control, Random signal analysis in noise, Monte Carlo simulations, Introduction to MATLAB/Python for random process simulation, Case studies	**6**

Text Books:

1. Alberto Leon-Garcia, "Probability and Random Processes for Electrical Engineering", Pearson,
2. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", Pearson,
3. P.Z. Peebles, "Probability, Random Variables and Random Signal Principles", McGraw Hill

Reference Books:

1. Simon Haykin, "Communication Systems", Wiley,
2. Y. Viniotis, "Probability and Random Processes for Electrical Engineers", McGraw Hill,
3. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", McGraw Hill

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Title of the Course Name: Advanced Digital Signal Processing	**L**	**T**	**P**	**Credits**
Course Code: P25ET102	3	1	--	4

Pre-Requisite: Basic Digital Signal Processing, Linear Algebra, Signals and Systems, Fourier Transform, MATLAB/Python basics

Course Objectives: The course aims:

1. To understand advanced methods for designing FIR and IIR filters.
2. To study multirate signal processing and spectral estimation techniques.
3. To explore adaptive filtering algorithms and their applications.
4. To apply time-frequency and wavelet-based methods in signal analysis.

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

CO	Course Outcomes	Bloom's Level
CO1	Design and analyze advanced FIR and IIR filters	AN
CO2	Apply multirate signal processing and spectral estimation techniques	A
CO3	Implement adaptive filtering algorithms for practical applications	A
CO4	Perform time-frequency analysis and apply DSP in real-world scenarios	A,AN

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Advanced FIR and IIR Filter Design** Review of FIR and IIR design concepts, ideal and practical characteristics, windowing techniques, frequency sampling method, frequency transformation, least-squares design, Parks-McClellan algorithm, direct, cascade and parallel forms, analog and digital transformation, lattice structures, pole-zero plots, Jury's test	**6**
2	**Multirate Signal Processing** Multirate principles, decimation, interpolation, rational rate conversion, sampling rate converters, multistage implementations, filter design, polyphase decomposition, sub-band coding, filter banks, transmultiplexers	**6**
3	**Power Spectrum Estimation** Spectral estimation, Periodogram, modified periodogram, Welch's method, Blackman-Tukey method, windowing, bias and variance, AR, MA, ARMA models, Yule-Walker equations, Burg's method, model order selection, resolution, leakage	**6**
4	**Adaptive Filters** Adaptive filtering concepts, LMS algorithm, Normalized LMS, Sign LMS, convergence behavior, RLS algorithm, complexity comparison, system identification, noise cancellation, echo cancellation, channel equalization	**6**
5	**Time-Frequency Analysis** Fourier limitations, STFT, spectrogram, time-frequency tiling, Heisenberg uncertainty, CWT, DWT, wavelet filter banks, multiresolution analysis, STFT comparison, transient and non-stationary analysis	**6**
6	**DSP Applications** Audio filtering, compression, echo reduction, ECG filtering, EEG noise removal, real-time processing, speech enhancement, pitch detection, speech coding	**6**

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Text Books:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson
2. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley
3. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw Hill

Reference Books:

1. A. V. Oppenheim, R. W. Schafer, Discrete-Time Signal Processing, Pearson
2. Simon Haykin, Adaptive Filter Theory, Pearson
3. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital Signal Processing: A Practical Approach, Pearson

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Title of the Course Name: Advanced Digital Communication **Course Code:**P25ET103	**L**	**T**	**P**	**Credits**
	3	1	--	4

Pre-Requisite: Fundamentals of Signals and Systems, Basics of Analog and Digital Communication, Linear Algebra and Probability Theory

Course Objectives: The course aims:

1. To review foundational principles of digital communication systems
2. To explore advanced modulation and coding techniques for reliable data transmission in various channels.
3. To analyze equalization and synchronization methods for mitigating ISI and maintaining coherent reception in practical systems.
4. To introduce multicarrier, spread spectrum, and MIMO technologies.

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

CO	Course Outcomes	Bloom's Level
CO1	Analyze digital modulation techniques and evaluate their performance in AWGN and fading channels.	AN,E
CO2	Apply error control coding techniques in communication systems.	A
CO3	Evaluate equalization and synchronization techniques for combating channel impairments.	E
CO4	Compare multicarrier, spread spectrum, and MIMO systems for high-capacity wireless applications.	AN

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Review of Digital Communication and Channel Models:** Baseband and passband transmission, Power and bandwidth efficiency, Gaussian and fading channels, Channel capacity, Shannon limit, Eye diagrams and BER performance	**6**
2	**Advanced Modulation Techniques:** QAM, PSK, DPSK, MSK, GMSK, Trellis-coded modulation (TCM), Performance of modulation techniques in AWGN and fading environments	**6**
3	**Error Control Coding:** Linear block codes, Cyclic codes, Convolutional codes, Viterbi algorithm, Turbo codes, LDPC codes, Coding gain and decoding complexity	**6**
4	**Equalization and Synchronization:** ISI and channel equalization, Linear and decision feedback equalizers, Adaptive equalization using LMS algorithm, Carrier and symbol synchronization, Timing recovery	**6**
5	**Multicarrier and Spread Spectrum Systems:** Principles of OFDM and DMT, PAPR reduction techniques, CDMA and DSSS techniques, FHSS, RAKE receiver, Comparison of multicarrier and spread spectrum methods	**6**
6	**MIMO and Advanced Wireless Technologies:** MIMO system models and spatial multiplexing, Diversity and beamforming, Channel estimation in MIMO systems, 4G/5G standards, Applications in broadband and IoT	**6**

Text Books:

1. Simon Haykin, "Digital Communication Systems", Wiley,
2. John G. Proakis and MasoudSalehi, "Digital Communications", McGraw Hill,
3. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson

Reference Books:

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", Pearson,
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press,
3. UpenaDalal, "Wireless and Mobile Communication", Oxford University Press

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Program Elective – I			
Sr. No.	**Course Code**	**Course Name**	**Semester**
1	P25ET104A	RF and Microwave Circuit Design	I
2	P25ET104B	VLSI architectures for Signal Processing	
3	P25ET104C	Soft Computing	

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Title of the Course Name: RF and Microwave Circuit Design	**L**	**T**	**P**	**Credits**
Course Code:P25ET104A	3	1	--	4

Pre-Requisite: Basic knowledge of Electronic Devices and Circuits, Fundamentals of Analog and Digital Communication, Network Theory

Course Objectives: The course aims:

1. To introduce the fundamental principles of RF design
2. To study the high-frequency behavior of electronic components and devices.
3. To design and analyze RF amplifiers, oscillators, and mixers for various communication and radar applications.
4. To familiarize students with RF measurement techniques and simulation tools used for design validation and performance evaluation.

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

CO	Course Outcomes	Bloom's Level
CO1	Analyze the behavior of passive and active components at RF and microwave frequencies.	AN
CO2	Design impedance matching networks using analytical methods and Smith chart techniques.	C
CO3	Design and evaluate RF amplifiers, oscillators, and mixers based on performance, stability, and noise.	E
CO4	Perform RF measurements and simulate RF circuits using modern EDA tools.	A

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Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to RF Design:** RF and microwave spectrum, RF behavior of passive components , Transmission lines and distributed effects , Smith chart basics , S-parameters, Introduction to matching networks	**6**
2	**High-Frequency Behavior of Devices:** RF diodes and transistors, Device modeling at RF frequencies, Parasitics and packaging effects, Scattering parameters in active devices, Noise and nonlinearity considerations, Stability of RF circuits	**6**
3	**Impedance Matching and Network Design:** Impedance transformation techniques, Single and double stub matching, L, Pi and T matching networks, Use of Smith chart in matching, Bandwidth considerations.	**6**
4	**RF Amplifier Design:** Types of RF amplifiers, Biasing techniques, Design of low-noise amplifiers (LNA), Power amplifiers and efficiency, Stability circles and gain analysis	**6**
5	**Oscillators and Mixers:** RF oscillator fundamentals, Negative resistance and feedback oscillators, Phase noise and frequency stability, Mixer topologies and performance, Image rejection and conversion gain.	**6**
6	**RF Measurements and Simulation Tools:** RF measurement techniques, Network analyzers and spectrum analyzers, Noise figure and power measurements, Antenna measurements, Introduction to RF simulation software (ADS, HFSS, etc.)	**6**

Text Books:

1. Reinhold Ludwig, Pavel Bretchko, "RF Circuit Design: Theory and Applications", Pearson Education.
2. Guillermo Gonzalez, "Microwave Transistor Amplifiers: Analysis and Design", Prentice Hall.

Reference Books:

1. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press.
2. Ulrich L. Rohde, David P. Newkirk, "RF/Microwave Circuit Design for Wireless Applications", Wiley.
3. Devendra K. Misra, "Radio-Frequency and Microwave Communication Circuits: Analysis and Design", Wiley-Interscience..

Title of the Course Name: VLSI Architectures for Signal Processing Course Code:P25ET104B	L	T	P	Credits
	3	--	--	3

Pre-Requisite: Logic Design, DSP Fundamentals, VLSI Basics

Course Objectives: The course aims:

1. To introduce the role of VLSI in modern digital signal processing (DSP) systems.
2. To explore pipelining, parallelism, and fast algorithm architectures to optimize common DSP operations in hardware.
3. To develop low-power and adaptive filter architectures suitable for implementation on VLSI platforms.
4. To enable system-level integration of DSP modules in SoC/FPGA environments, covering real-world applications like speech, image, and biomedical signal processing.

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

CO	Course Outcomes	Bloom's Level
CO1	Analyze DSP functions and design metrics for efficient hardware mapping in VLSI systems.	AN
CO2	Design pipelined and parallel DSP architectures using optimization techniques such as folding and retiming.	C
CO3	Implement adaptive filters and low-power techniques for real-time DSP applications in hardware.	A
CO4	Integrate DSP architectures into SoC or FPGA using HDL flows and evaluate case studies in practical domains.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Fundamentals of VLSI for DSP** Overview of VLSI in signal processing systems, Design Metrics: performance, area, power, Dataflow models and DSP mapping techniques, Typical DSP Kernels in hardware.	**6**
2	**Pipelining and Parallel Processing** Pipeline concepts in filter architectures, Interleaving and critical path reduction, Parallel FIR/IIR implementations, Case studies: pipelined IIR, parallel FIR blocks.	**6**
3	**Fast Convolution and Transform Architectures** Efficient convolution algorithms: Cook-Toom, Cyclic approaches, FFT/DCT hardware architectures, Strength reduction and folding techniques.	**6**
4	**Architectures for Adaptive Filters** LMS, RLS algorithm mapping, Hardware-efficient structures, Convergence, numerical stability in VLSI.	**6**
5	**Low-Power DSP Design** Sources of power consumption in DSP hardware, Techniques: clock gating, operand isolation, voltage scaling, Application in filters, transforms.	**6**
6	**Advanced Applications & SoC Integration** Architectures for multirate systems and filter banks, VLSI for speech, image, biomedical signal processing, Integration into SoC/FPGA with HDL/ASIC flows, Case Studies - DCT in JPEG, ECG Processing Unit.	**6**

Text Books:

1. VLSI Digital Signal Processing Systems: Design and Implementation – K. K. Parhi, Wiley, 1999.
2. Architectures for Digital Signal Processing – Wiley.
3. VLSI Architectures for Signal, Speech, and Image Processing – Nandan et al., Apple Academic, 2022.

Reference Books:

1. VLSI Design Methodologies for Digital Signal Processing Architectures – Bayoumi (Springer, 1994 / 2012).
2. Pipelined Lattice and Wave Digital Recursive Filters – Chung &Parhi, Kluwer.
3. Digital Signal Processing for Multimedia Systems – Parhi&Nishitani, Marcel Dekker.

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Title of the Course Name: Soft Computing	**L**	**T**	**P**	**Credits**
Course Code:P25ET104C	3	--	--	3

Pre-Requisite: Fundamentals of Mathematics (Linear Algebra, Probability, Calculus) , Programming knowledge (preferably Python or MATLAB)

Course Objectives: The course aims:

1. To introduce the fundamentals and characteristics of soft computing.
2. To understand the principles and applications of Fuzzy Logic, Neural Networks, and Genetic Algorithms in modeling and decision-making.
3. To explore hybrid systems that integrate multiple soft computing methods to solve complex, uncertain, and nonlinear problems.
4. To apply soft computing techniques in real-world engineering problems.

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

CO	Course Outcomes	Bloom's Level
CO1	Differentiate between hard and soft computing and explain the role of soft computing in complex problem-solving.	U
CO2	Apply fuzzy logic, neural networks, and genetic algorithms to various engineering and decision-making problems.	A
CO3	Analyze the structure, training, and performance of neural networks and fuzzy systems.	AN
CO4	Design hybrid soft computing models for real-life applications.	C

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Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Soft Computing:** Overview of soft computing: Definition, importance, and characteristics, Difference between soft computing and hard computing, Advantages of soft computing in handling uncertainty, imprecision, and complexity	**6**
2	**Fuzzy Logic (FL) :** Introduction to fuzzy sets and membership functions, Fuzzy inference systems: Mamdani and Sugeno models, Applications of fuzzy logic in decision-making and control systems	**6**
3	**Artificial Neural Networks (ANNs):** Basics of neural networks: Perceptrons and activation functions, Training neural networks using backpropagation, Exploring architectures: Feedforward, convolutional, and recurrent neural networks, Applications of ANNs in pattern recognition and prediction	**6**
4	**Genetic Algorithms (GAs):** Fundamentals of genetic algorithms: Selection, crossover, and mutation, Optimization techniques inspired by biological evolution, Solving complex optimization problems using GAs, Applications in engineering, scheduling, and machine learning	**6**
5	**Hybrid Systems:** Concept of hybrid systems: Combining FL, ANNs, GAs, Synergies between techniques to solve complex problems, Real-world examples of hybrid systems in adaptive control and decision-making	**6**
6	**Applications of Soft Computing** : Case studies in pattern recognition, data mining, and control systems, Applications in robotics, healthcare, and financial forecasting, Benefits of soft computing in solving real-world challenges	**6**

Text Books:

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India.
2. Rajasekaran and Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI..

Reference Books:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley.
2. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson.

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Title of the Course Name: Research Methodology and IPR	L	T	P	Credits
Course Code: P25ET105	2	--	--	2

Prerequisite:-

Course Objectives: The course aims:

1. To introduce the fundamental principles and process of research.
2. To develop the ability to apply statistical and analytical tools for data collection, interpretation, and hypothesis testing.
3. To promote awareness of research ethics and responsible conduct, including issues like plagiarism and publication ethics.
4. To provide an overview of Intellectual Property Rights (IPR) and guide learners through patent filing procedures and case studies.

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

CO	Course Outcomes	Bloom's Level
CO1	Understand the fundamentals of research methodology and its role in systematic investigation.	U
CO2	Apply research design concepts and statistical methods in solving real-world research problems.	A
CO3	Analyze ethical issues in research and follow appropriate research practices and publication norms.	AN
CO4	Explain the significance of IPR and outline procedures for patent filing and licensing.	U

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Research Methodology:** Meaning, Objectives, Motivation, Types of Research, Research Approaches, Research Process, Criteria of Good Research	**4**
2	**Research Problem and Design:** Identifying Research Problem, Literature Survey, Research Objectives, Research Design Concepts, Features of Good Design	**4**
3	**Data Collection and Analysis:** Sources of Data, Sampling Methods, Data Processing, Statistical Techniques, Hypothesis Testing, Report Writing	**4**
4	**Ethics in Research** Ethical Principles, Plagiarism, Impact of Misconduct, Ethical Committees, Publishing Ethics	**4**
5	**Introduction to IPR** Overview of Intellectual Property, Importance of IPR, Types: Patents, Trademarks, Copyrights, Industrial Designs	**4**
6	**IPR Procedures and Case Studies** Patent Filing Procedure, Patentable and Non-patentable Items, Patent Search, Licensing, Case Studies on IPR Disputes	**4**

Text Books:

1. C. R. Kothari – "Research Methodology: Methods and Techniques", New Age International
2. P. Pandey & S. Pandey – "Research Methodology: Tools and Techniques", Bridge Center
3. Neeraj Pandey, KhushdeepDharni – "Intellectual Property Rights", PHI Learning

Reference Books:

1. Ranjit Kumar – "Research Methodology: A Step-by-Step Guide", Sage Publications
2. T. Ramakrishna – "Basic Principles and Acquisition of Intellectual Property Rights", CIPRA, NLSIU
3. V. Scaria – "Intellectual Property Rights in the Global Era", LexisNexis

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Experiential Learning Course

Title of the Course Name: Seminar Course Code: P25ET106	L	T	P	Credits
	--	--	2	1

Pre-Requisite: Core subject Knowledge, Technical writing skill and Presentation skill

Course Objectives: The course aims:

1. To encourage students to explore, analyze, and present emerging research trends in Electronics and Telecommunication.
2. To develop the ability to conduct in-depth technical literature reviews using scholarly and scientific sources.
3. To improve technical writing and documentation skills through structured report writing.
4. To build confidence in delivering academic and professional presentations.
5. To strengthen communication, critical thinking, and professional ethics in the context of E&TC innovations.

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

CO	Course Outcomes	Bloom's Level
CO1	Identify advanced and emerging topics relevant to the E&TC field.	A
CO2	Perform critical literature reviews using peer-reviewed journals and industry sources.	AN
CO3	Write a well-structured technical report using proper formatting, citation, and referencing styles.	C
CO4	Deliver a formal seminar presentation with clarity, coherence, and confidence.	A
CO5	Effectively respond to technical queries and participate in academic discussions.	E
CO6	Demonstrate academic integrity, professional ethics, and independent learning	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Sr.No.	Guidelines
1	**Topic Selection:** • The topic should be recent, innovative, and relevant to the E&TC domain (e.g., 5G/6G, AI in wireless, quantum communication, IoT security, SDR, VLSI design trends, etc.). • Finalize in consultation with a Guide.
2	**Literature Survey:** • **Use IEEE Xplore, Springer, Elsevier, ScienceDirect, ACM, etc.** • **Minimum 15–20 references from recent publications (preferably last 5 years).** • **Maintain a citation style (IEEE preferred in E&TC).**
3	**Report Writing:** • Cover Page with title, student name, guide name, institution. • Abstract (150–250 words). • Introduction. • Literature Review. • Technical Discussion / Methodology. • Challenges and Research Gaps. • Conclusion and Future Scope. • References (IEEE format).
4	**Presentation:** • **Duration**: 12–15 minutes + 5 minutes Q&A. • Use professional PowerPoint slides: ○ 12–20 slides covering title, abstract, objectives, literature review, analysis, conclusion. • Include diagrams, block diagrams, or simulation results if applicable.
6	**Submission Requirements:** • **Final seminar report** (spiral bound and PDF). • **Presentation file** (PPT/PDF).

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Program Core Courses Lab

Title of the Course Name: PG Lab-I Course Code: P25ET107	L	T	P	Credits
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Part-I: Advanced Digital Signal Processing Lab

Pre-Requisite: fundamental DSP concepts, Z-transform, Fourier analysis, and digital filter design. Basic proficiency in MATLAB or Python.

Course Objectives: The course aims:

1. To explore and implement advanced concepts in digital signal processing through practical experiments.
2. To strengthen the analytical and computational skills required for filter design, spectral analysis, and adaptive systems.
3. To gain experience with multirate signal processing, time-frequency methods, and real-time signal applications.
4. To build competence in applying DSP techniques to modern communication and multimedia systems.

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

CO	Course Outcomes	Bloom's Level
CO1	Apply digital filter design techniques to develop and analyze FIR and IIR filters.	A
CO2	Interpret frequency domain characteristics of signals using spectral estimation methods.	AN
CO3	Demonstrate proficiency in multirate processing and its impact on signal quality.	A
CO4	Implement and compare adaptive filtering techniques for signal improvement applications.	A
CO5	Utilize time-frequency methods for analyzing non-stationary signals.	A
CO6	Design and simulate real-time DSP applications relevant to modern engineering problems.	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Experiment No.	**Experiment Title**	**Hrs**
1	Design and analyze FIR filters using window techniques and evaluate the magnitude and phase response.	2
2	Implement IIR filters using bilinear transformation and impulse invariance methods and validate the filter characteristics.	2
3	Perform spectral estimation using Periodogram, Welch, and Yule-Walker methods for real and synthetic signals.	2
4	Simulate multirate signal processing operations including decimation and interpolation and analyze aliasing effects.	2
5	Implement Fast Fourier Transform (FFT) and compare its performance and accuracy with the Discrete Fourier Transform (DFT).	2
6	Design and simulate an adaptive filter using the Least Mean Square (LMS) algorithm for noise cancellation.	2
7	Implement Recursive Least Squares (RLS) adaptive filter and compare its convergence performance with LMS.	2
8	Analyze time-frequency characteristics of signals using Short-Time Fourier Transform (STFT) and generate spectrograms.	2
9	Apply wavelet transform techniques for signal analysis and compare with Fourier-based spectral techniques.	2
10	Implement real-time signal processing tasks such as echo cancellation or speech enhancement using digital filters.	2

Note: *Minimum 08 experiments to be performed.

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Part-II: Advanced Digital Communication Lab

Pre-Requisite: Basic understanding of digital communication techniques, Familiarity with MATLAB or Python for simulations, Knowledge of signal transmission and noise effects in communication systems.

Course Objectives: The course aims:

1. To understand and implement digital modulation and demodulation techniques.
2. To analyze the performance of communication systems under various channel conditions.
3. To learn about error control coding and simulate simple coding techniques.
4. To gain practical knowledge of modern communication concepts such as OFDM and spread spectrum.
5. To use simulation tools to evaluate and compare different digital communication schemes.

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

CO	Course Outcomes	Bloom's Level
CO1	Implement basic and advanced digital modulation techniques.	A
CO2	Evaluate system performance using bit error rate under different noise and channel conditions.	E
CO3	Simulate error control codes and understand their impact on communication reliability.	A
CO4	Apply multicarrier and spread spectrum techniques to improve system performance.	A
CO5	Apply simulation tools to model and test communication system components.	A,E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Experiment No.	**Experiment Title**	**Hrs**
1	Simulate Amplitude Shift Keying (ASK) modulation and demodulation.	2
2	Simulate Frequency Shift Keying (FSK) modulation and demodulation.	2
3	Simulate Phase Shift Keying (PSK) modulation and demodulation.	2
4	Compare the Bit Error Rate (BER) performance of BPSK and QPSK in AWGN channel.	2
5	Implement Hamming code for error detection and correction.	2
6	Simulate the effect of noise on digital modulation schemes and observe output.	2
7	Implement convolutional encoding and Viterbi decoding.	2
8	Demonstrate basic OFDM system using IFFT and FFT blocks.	2
9	Simulate Direct Sequence Spread Spectrum (DSSS) system.	2
10	Compare performance of coherent and non-coherent detection techniques.	2

Note: *Minimum 08 experiments to be performed.

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Audit Course

Title of the Course Name: Yoga and Meditation Course Code: P25ET108	L	T	P	Credits
	1	--	--	--

Pre-Requisite: Basic understanding of human anatomy and interest in physical and mental well-being

Course Objectives:

1. To explore the philosophical and psychological foundations of Yoga and Meditation.
2. To introduce and practice the Eight Limbs of Yoga (*Ashtanga Yoga*) for holistic self-regulation.
3. To train students in meditation, breathing, and ethical practices for enhancing clarity, focus, and emotional balance.
4. To help students integrate yogic wisdom and mindfulness

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

CO	Course Outcomes	Bloom's Level
CO1	Comprehend the core teachings of *Yoga Sutras*.	U
CO2	Practice foundational yogic techniques.	A
CO3	Apply principles of *Yama* and *Niyama* for improved discipline, ethics, and self-awareness.	A
CO4	Develop concentration and mindfulness for stress reduction and productivity.	A

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Course Content		
Unit No.	**Content**	**Hrs**
1	**Foundations of Yoga Philosophy** Origin and evolution of Yoga; Introduction to Yoga Sutras.Definition of Yoga – *"Yogas Chitta Vritti Nirodha"*. The five *Vridettis* (mental fluctuations) and their control.	**03**
2	**Ethical and Personal Discipline (Yama & Niyama)** The five Yamas – Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha. The five Niyamas – Shaucha, Santosha, Tapas, Svadhyaya, Ishwar Pranidhana. Relevance of Yama-Niyama in academic and professional life.	**03**
3	**Physical & Mental Purification (Asana, Pranayama, Pratyahara)** *Asana* – Role of posture; stability and comfort in the body Pranayama – Breath control techniques; calming the nervous system Pratyahara – Withdrawal of senses; mastering inner awareness	**03**
4	**Concentration, Meditation, and Liberation (Dharana, Dhyana, Samadhi)** Dharana – Developing concentration and focus Dhyana – The process and practice of meditation Samadhi – State of absorption; experiencing inner peace and unity	**03**

References:

1. Swami Satchidananda, *The Yoga Sutras of Patanjali*
2. B.K.S. Iyengar, *Light on the Yoga Sutras of Patanjali*
3. Swami Satyananda Saraswati , *Four Chapters on Freedom*
4. Swami Vivekananda ,*Raja Yoga*

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Semester: II

Title of the Course Name: Advanced Embedded System **Course Code:**P25ET201	**L**	**T**	**P**	**Credits**
	3	1	--	4

Pre-Requisite: Microprocessors and Microcontrollers

Course Objectives: The course aims:

1. To introduce the ARM Cortex-M architecture
2. To develop the ability to write efficient assembly and C-based embedded programs using the Cortex-M platform.
3. To understand interrupt handling, peripheral interfacing, and real-time software design for embedded applications.
4. To apply RTOS concepts and debugging tools in developing reliable, low-power embedded systems using ARM Cortex-M microcontrollers.

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

CO	Course Outcomes	Bloom's Level
CO1	Explain the architecture, instruction set, and programming model of ARM Cortex-M cores.	U
CO2	Develop embedded programs using Cortex-M assembly/C and configure interrupts and peripherals.	A
CO3	Analyze RTOS concepts and implement multitasking using CMSIS-RTOS/Free RTOS.	AN
CO4	Design, implement, and debug embedded applications using IDEs and in-system programming tools.	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to ARM Cortex-M Architecture** Overview of Cortex-Mfamilies (M0, M3, M4, M7), Harvard architecture, pipelining, and Thumb-2 instruction set, Register set, modes, and privilege levels, Memory map and bit-banding	**6**
2	**ARM Cortex-M Programming Model** Cortex-M instruction set and assembly programming, Stack operations, function calls, inline assembly, NVIC (Nested Vectored Interrupt Controller) and system control block,Introduction to CMSIS and startup code	**6**
3	**Exceptions and Interrupts** Exception types and priorities, Vector table, ISR, and context switching, Interrupt enabling/disabling and preemption, Exception handling using SCB registers	**6**
4	**On-chip Peripherals and Interfacing** GPIO configuration and I/O programming, UART, SPI, I2C interfacing, ADC, DAC, PWM, Timers, Real-time clock and watchdog timer	**6**
5	**RTOS and Embedded Software Design** Need for RTOS in embedded systems**,** Task management, context switching**,** Inter-task communication: Semaphores, Queues**,** Scheduling algorithms and priorities**,** RTOS using CMSIS-RTOS/FreeRTOS with STM32	**6**
6	**Application Development and Debugging** IDEs: KeiluVision, STM32CubeIDE, In-system programming and debugging tools (JTAG/SWD), Performance optimization and power management, Case studies: Data Logger, Control System	**6**

Text Books:

1. Joseph Yiu, The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors
2. Jonathan Valvano, Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers
3. Yifeng Zhu, ARM Cortex-M Assembly Programming for Embedded Developers

Reference Books:

1. Andrew Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide
2. Brian Amos (Packt), Hands-On RTOS with Microcontrollers
3. Alexander G. Dean, Embedded Systems Fundamentals with ARM Cortex-M

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Title of the Course Name: Image Processing and Computer Vision **Course Code:** P25ET202	**L**	**T**	**P**	**Credits**
	3	1	--	4

Pre-Requisite: Linear Algebra, Vector Calculus, Data Structures and Programming

Course Objectives: The course aims:

1. To understand image fundamentals and how digital images can be processed
2. To understand image enhancement, image compression techniques and its application
3. Fundamentals of computer vision, geometrical features of images, object recognition
4. Explore application of real time image processing.

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

CO	**Course Outcomes**	**Bloom's Level**
CO1	Understand image formation, representation, and enhancement techniques in both spatial and frequency domains.	U
CO2	Apply filtering and compression techniques for improving and storing digital images.	A
CO3	Analyze real-time image processing systems and develop algorithms.	AN
CO4	Design and implement computer vision-based applications for object detection, tracking, and interaction.	C

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Course Content		
Unit No.	**Contents**	**Hrs**
1	**Digital Image Fundamentals:** A Simple Image Model, Sampling and Quantization, Relationship between Pixel, Image Formats and Image Transforms	**6**
2	**Image Enhancement:** Histogram processing, image subtraction, image averaging, smoothing filters, sharpening filters, enhancement in frequency and spatial domain, low pass filtering, high pass filtering..	**6**
3	**Image Compression:** Fundamentals, Image Compression Models, Elements of Information Theory, Error-Free Compression, Lossy Compression, Recent Image Compression Standards.	**6**
4	**Real Time Image Processing:** Introduction to Digital Signal Processor (TMS320CXX), Introduction to Texas Instruments Image Library, Development of a real time image processing algorithms	**6**
5	**Computer Vision:** Imaging Geometry, Coordinate transformation and geometric warping for image registration, Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component Analysis, Shape priors for recognition, Implementation of computer vision algorithms using Raspberry Pi.	**6**
6	**Image Processing and Computer Vision Applications:** Denoising of Image as preprocessing, Object recognition, Motion estimation, Object Tracking, Vision based control, vision for human computer interaction	**6**

Text Books:

1. Gonzalez, R.C., and Woods, R.E., Digital Image Processing, Dorling Kingsley (2009) 3rd Edition
2. D. Forsyth and J. Ponce, Computer Vision - A modern approach, Prentice Hall.

Reference Books:

1. Jain A.K., Fundamentals of Digital Image Processing, Prentice Hall (2007).
2. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Prentice Hall.
3. Sonka M., Image Processing and Machine Vision, Prentice Hall (2007) 3rd Edition

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Title of the Course Name: Network Security and Cryptography **Course Code:**P25ET203	**L**	**T**	**P**	**Credits**
	3	--	--	3

Pre-Requisite: Basic understanding of computer networks, Fundamentals of programming and discrete mathematics

Course Objectives: The course aims:

1. To understand the fundamentals of network security, including types of attacks, threats, and security mechanisms.
2. To study classical and modern cryptographic algorithms for ensuring confidentiality and data protection.
3. To explore public key cryptography, authentication techniques, and network-level security protocols.
4. To familiarize students with real-world security tools and applications, including intrusion detection and digital forensics.

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

CO	**Course Outcomes**	**Bloom's Level**
CO1	Understand security principles, attack types, cryptographic goals, and common vulnerabilities.	U
CO2	Apply symmetric and asymmetric cryptographic techniques for secure communication.	A
CO3	Analyze security protocols, authentication methods, and network security tools in wired/wireless setups.	AN
CO4	Design and evaluate secure systems using cryptographic tools and cybersecurity techniques.	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Network Security:** Security basics and objectives (confidentiality, integrity, availability), Types of attacks: passive and active, Threats in wired and wireless networks, Security services and mechanisms, Security policies and practices, Introduction to cryptography	**6**
2	**Classical Cryptographic Techniques :** Caesar cipher, Monoalphabetic and polyalphabetic ciphers, Playfair cipher and Hill cipher, Transposition techniques, Cryptanalysis and brute-force attacks, Strengths and weaknesses of classical methods	**6**
3	**Modern Symmetric Key Cryptography :** Block ciphers and stream ciphers, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Modes of operation (ECB, CBC), Security of symmetric key algorithms, Hands-on with tools: CrypTool or Python	**6**
4	**Public Key Cryptography and Authentication :** Principles of public key cryptography, RSA algorithm and its applications, Key distribution and management, Hash functions: MD5, SHA, Digital signatures and certificates, Authentication protocols (Kerberos, Challenge-Response)	**6**
5	**Network Security Mechanisms :** Secure email and secure web, SSL/TLS protocols, IP security (IPSec), Firewalls and VPNs, Intrusion detection systems (IDS), Wi-Fi and wireless network security basics	**6**
6	**Applications and Security Tools :** Cybersecurity in real-world domains: banking, e-commerce, IoT, Introduction to ethical hacking and penetration testing, Security tools: Wireshark, Nmap, Snort, Cyber laws and digital forensics basics, Mini-project or case study presentation	**6**

Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson,
2. Behrouz A. Forouzan, "Cryptography and Network Security", McGraw Hill,
3. AtulKahate, "Cryptography and Network Security", Tata McGraw Hill

Reference Books:

1. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private Communication in a Public World", Pearson,
2. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C", Wiley,
3. Mark Stamp, "Information Security: Principles and Practice", Wiley

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Program Elective-II

Program Elective – II			
Sr. No.	**Course Code**	**Course Name**	**Semester**
1	P25ET204A	5G and Edge Computing	II
2	P25ET204B	Mixed Signal and RF Circuit Design	
3	P25ET204C	Artificial Intelligence and Machine Learning	

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Title of the Course Name: 5G and Edge Computing	**L**	**T**	**P**	**Credits**
Course Code: P25ET204A	3	--	--	3

Pre-Requisite: Fundamentals of Wireless Communication, Computer Networks, Basics of Cloud Computing, IoT and Network Protocols

Course Objectives: The course aims:

1. Understand the architecture and key technologies of 5G networks.
2. Learn the role and significance of edge computing in 5G ecosystems.
3. Analyze the integration of 5G with edge computing for real-time and latency-sensitive applications.
4. Explore use-cases, deployment challenges, and security concerns in 5G and edge environments.

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

CO	Course Outcomes	Bloom's Level
CO1	Describe the architecture and enabling technologies of 5G networks.	R
CO2	Explain the principles and components of edge computing.	U
CO3	Analyze the synergy between 5G and edge computing for various use cases.	AN
CO4	Evaluate security, QoS, and performance trade-offs in 5G edge deployments.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to 5G:** Evolution from 1G to 5G, 5G use cases (eMBB, URLLC, mMTC), Key features of 5G (network slicing, massive MIMO, mmWave, etc.), 5G NR (New Radio) architecture,	**6**
2	**5G Network Architecture:** 5G Core Network (5GC) and NR, Control and user plane separation, SDN and NFV in 5G, Service-Based Architecture (SBA),	**6**
3	**5G Network Architecture:** 5G Core Network (5GC) and NR, Control and user plane separation, SDN and NFV in 5G, Service-Based Architecture (SBA),	**6**
4	**Introduction to Edge Computing:** Definition and architecture of edge computing, Fog vs Edge vs Cloud computing, Edge infrastructure and components, Edge datacenters and access networks,	**6**
5	**Challenges and Security in 5G Edge Networks:** Resource management and orchestration in 5G edge, Security and privacy issues in edge computing, QoS and SLA management, Deployment challenges in large-scale systems,	**6**
6	**Case Studies and Future Trends:** Case studies on 5G and edge integration (smart cities, vehicular networks, IoT), AI/ML at the edge, 6G and future trends	**6**

Text Books:

1. **Pawel Kryszczuk, Amir Dianat** – *5G and Edge Computing: Emerging Technologies and Applications*, Springer, 2021
2. **Wendell Odom** – *Fundamentals of 5G Mobile Networks*, Wiley, 2019

Reference Books:

1. **Jonathan Rodriguez** – *Fundamentals of 5G Mobile Networks*, Wiley, 2015
2. **Tao Zhang, Rajeev Tewari** – *Edge Computing: Models, Technologies and Applications*, Wiley, 2021

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Title of the Course Name: Mixed Signal and RF Circuit Design **Course Code:**P25ET204B	**L**	**T**	**P**	**Credits**
	3	--	--	3

Pre-Requisite: Analog CMOS circuit fundamentals, Digital/VLSI design basics, Signals & systems theory, Electromagnetics and RF basics.

Course Objectives: The course aims:

1. To understand the fundamentals of CMOS analog, mixed-signal, and RF circuit design.
2. To explore the architecture and non-idealities of data converters and clocking circuits.
3. To analyze and design essential RF circuit blocks
4. To introduce verification techniques, system integration, and case studies in RF-CMOS systems.

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

CO	Course Outcomes	Bloom's Level
CO1	Understand CMOS device models, mixed-signal design principles, and RF fundamentals.	U
CO2	Apply knowledge to design and analyze ADCs, DACs, PLLs, and RF front-end circuits.	A,AN
CO3	Evaluate system-level performance of mixed-signal and RF blocks considering noise, non-linearity, and jitter.	E
CO4	Design integrated mixed-signal systems using simulation tools and demonstrate system integration techniques.	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Foundations of Mixed-Signal and RF CMOS** CMOS analog and mixed-signal fundamentals: device models, parasitics, feedback and stability, RF-CMOS technology overview and applications in modern wireless systems, Introduction to mixed-signal IC blocks - AM, ADC/DAC, sample-and-hold.	**6**
2	**Data Converters** DAC architectures: binary-weighted, current-steering, thermometer, mismatch issues, ADC types: flash, successive approximation, pipeline, sigma-delta; non-idealities and design trade-offs	**6**
3	**Sample-and-Hold, PLL and Clocking** S/H circuit topologies and charge injection problems, Phase-Locked Loops: VCOs, dividers, phase detectors, loop filter design, lock behavior.	**6**
4	**RF Circuit Blocks** RF fundamentals: noise figure, gain compression, dynamic range, Friis formula, Receiver front ends: low-noise amplifiers (LNAs), mixers, heterodyne/homodyne architectures, Oscillator design: LC, ring types; phase noise, jitter, design trade-offs.	**6**
5	**Mixed-Signal Design & Verification** Integration of analog and digital: interface strategies, signal boundary considerations, Modeling with Verilog - A/Verilog - AMS; performance-driven synthesis and simulation, Testability and design-for-test (DFT) in mixed-signal circuits.	**6**
6	**System Integration** SoC integration: mixed-signal blocks in FPGA/ASIC flows, RF-CMOS design case studies in wireless transceivers - Wi-Fi, Bluetooth, GPS.	**6**

Text Books:

1. Design of Analog CMOS Integrated Circuits, BehzadRazavi, McGraw-Hill Education, second edition, 2015.
2. RF Microelectronics, BehzadRazavi, Prentice Hall / Pearson Education, 2nd ed. 2011.
3. Mixed-Signal Circuits (Devices, Circuits, and Systems), Thomas Noulis, CRC Press,2014.

Reference Books:

1. Analog/RF and Mixed-Signal Circuit Systematic Design, MouradFakhfakh et al., Springer,
2. Computational Intelligence in Analog and Mixed-Signal & RF Design, Springer, 2018.
3. RF CMOS Power Amplifiers & Transceivers – Fadhel M. Ghannouchi, Wiley, 2015.

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Title of the Course Name: Artificial Intelligence and Machine Learning Course Code:P25ET204C	L	T	P	Credits
	3	--	--	3

Pre-Requisite: Fundamentals of Mathematics (Linear Algebra, Probability, Calculus) , Programming knowledge (preferably Python or MATLAB)

Course Objectives: The course aims:

1. To introduce the fundamental concepts and evolution of Artificial Intelligence and Machine Learning.
2. To develop understanding of classical AI problem-solving, reasoning, and knowledge representation techniques.
3. To explore machine learning approaches and implement basic models using Python and ML libraries.
4. To analyze real-world AI/ML applications, ethical considerations, and future directions in intelligent systems.

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

CO	Course Outcomes	Bloom's Level
CO1	Define core concepts of AI, ML, and Deep Learning, and distinguish their roles and applications.	R
CO2	Apply problem-solving and reasoning techniques using classical AI methods like search and logic.	A
CO3	Build basic machine learning models and evaluate them using real-world datasets and metrics.	E
CO4	Examine applications of AI/ML, ethical challenges, and modern tools in various sectors.	A

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Course Content		
Unit No.	**Contents**	**Hrs**
1	**Unit 1: Introduction to AI and ML:** Definition of AI and ML, History and evolution, Applications in daily life, Difference between AI, ML, and Deep Learning, Overview of AI agents and environments, Tools used in AI/ML (Python, Jupyter, Google Colab)	**6**
2	**Unit 2: Search and Problem Solving in AI:** Problem-solving agents, Uninformed search: BFS, DFS, Informed search: Greedy, A* - Game playing: Minimax algorithm, Constraint satisfaction problems, Real-world examples	**6**
3	**Unit 3: Knowledge Representation and Reasoning:** Logical reasoning basics, Propositional and first-order logic (simple), Semantic networks and frames, Rule-based systems, Introduction to probabilistic reasoning (Bayes' theorem), Application in expert systems	**6**
4	**Unit 4: Introduction to Machine Learning:** ML process and lifecycle, Types of learning: Supervised, Unsupervised, Reinforcement, Basic concepts: Features, labels, model, training, Classification vs. regression, ML libraries: Scikit-learn basics, Simple dataset: Titanic/iris/housing example	**6**
5	**Unit 5: Building and Evaluating ML Models:** Data preprocessing (cleaning, encoding, scaling), Splitting data: Train,test , Algorithms: k-NN, Decision Trees, Linear Regression, Model accuracy, confusion matrix, Overfitting and underfitting, Hands-on project: Predict student marks/housing price	**6**
6	**Unit 6: Applications and Future of AI/ML:** AI/ML in real life: healthcare, robotics, agriculture Ethics and bias in AI, Introduction to AI tools: Chatbots, Recommendation Systems,AutoML and no-code ML tools, Future trends in AI and ML	**6**

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson.
2. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly.

Reference Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill.
2. EthemAlpaydin, "Introduction to Machine Learning", MIT Press.

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Open Elective-I

Course Code	Course Name (OE)
P25ET205A	Environment and Development
P25ET205B	Engineering Economics
P25ET205C	Project Management
P25ET205D	Healthcare Engineering

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Title of the Course Name: Environment and Development **Course Code:** P25CM205A/ P25CS205A/ P25ET205A/ P25MD205A / P25MP205A	**L**	**T**	**P**	**Credits**
	3	--	--	3

Pre-Requisite: Basic knowledge of environmental science and sustainable practices

Course Objectives: The course aims:

1. To introduce the interrelationship between environment and development.
2. To understand the causes and consequences of environmental degradation.
3. To evaluate sustainable development principles and ethical approaches to environmental issues.
4. To explore global environmental policies, governance, and contemporary challenges.

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

CO	**Course Outcomes**	**Bloom's Level**
CO1	Define concepts of environmental development, sustainability, and major environmental movements.	R
CO2	Explain natural resource issues and assess environmental degradation impacts.	U
CO3	Apply principles of sustainability and ethics to evaluate environmental decisions.	A
CO4	Analyze environmental governance, policies, and contemporary global issues through case studies.	AN

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Environment and Development** Definition and Scope, Need for Sustainable Development, Historical Background, Environmental Movements.	**6**
2	**Natural Resources and Environmental Degradation** Types of Natural Resources, Resource Depletion, Land Degradation, Pollution and Biodiversity Loss.	**6**
3	**Sustainable Development and Environmental Ethics** Principles of Sustainability, Environmental Ethics, Ecological Footprint, Green and Clean Technologies.	**6**
4	**Climate Change and Global Concerns** Climate Change Causes and Impacts, Global Warming, Carbon Cycle, Adaptation and Mitigation Strategies.	**6**
5	**Policy and Governance** Environmental Policies, Acts and Protocols (India & Global), Role of Government and NGOs, Environmental Impact Assessment (EIA).	**6**
6	**Contemporary Issues and Case Studies** Urbanization and Environment, Renewable Energy, Case Studies on Sustainable Practices in India and Abroad.	**6**

Text Books:

1. Rajagopalan R., "Environmental Studies: From Crisis to Cure" , Oxford University Press.
2. Erach Bharucha, "Textbook of Environmental Studies", UGC Publication.
3. Sharma P.D., " Ecology and Environment", Rastogi Publications.

Reference Books:

1. Cunningham W.P. & Cunningham M.A., "Principles of Environmental Science", Tata McGraw-Hill.
2. Botkin D.B. & Keller E.A., "Environmental Science: Earth as a Living Planet", Wiley India.
3. Sachs J.D., " The Age of Sustainable Development", Columbia University Press.

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Title of the Course Name: Engineering Economics Course Code: P25CM205B/ P25CS205B/ P25ET205B/P25MD205B / P25MP205B	L	T	P	Credits
	3	--	--	3

Pre-Requisite: Management Information Systems (MIS)

Course Objectives: The course aims:

1. To introduce fundamental economic principles relevant to engineering and decision-making.
2. To apply time value of money and interest formulas for evaluating engineering alternatives.
3. To analyze cost-based decisions such as make-or-buy, value engineering, and depreciation methods.
4. To compare alternative investments, assess replacement strategies, and understand project financing.

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

CO	Course Outcomes	Bloom's Level
CO1	Define basic economic terms and apply them in the context of engineering problems.	R,A
CO2	Illustrate the use of time value of money concepts and evaluate cash flows using different economic methods.	A
CO3	Analyze and compare alternatives using present worth, annual worth, and rate of return methods.	AN
CO4	Evaluate maintenance, replacement, depreciation, and public vs private project economics effectively.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction Engineering Economy** Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering – Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, P – V ratio, Elementary economic Analysis– Material selection for product, Design selection for a product, Process planning.	**6**
2	**Value Engineering** Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications– Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor–equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.	**6**
3	**Cash Flow** Methods of comparison of alternatives – Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), rate of return method, Examples in all the methods.	**6**
4	**Replacement And Maintenance Analysis** Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with an ewasset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.	**6**
5	**Depreciation** Depreciation – Introduction, Straight line method of depreciation, – Declining balance method of depreciation – Sum of the years digits method of depreciation, – Sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation – Evaluation of public alternatives – Introduction – Examples – Inflation adjusted decisions – Procedure to adjust inflation, Examples on comparison of alternatives	**6**

	and determination of economic life of asset.	
6	**Financing & Public vs Private Projects** Financing sources, economic evaluation in public projects, social costs, regulatory factors.	**6**

Text Books:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi,2001.
2. Suma Damodaran, " Managerial economics", Oxford university press2006
3. A Text book of Economic Theory: by stonier and hauge, pearson Publication.

Reference Books:

1. Sampat Mukherjee, Modern Economic Theory, New Age International Publisher
2. Degramo , Engineering Economics, prentice Hall.
3. Bo Sodersten, Macmillan, International Economics.

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Course Name: **Project Management** Course Code: P25CM205C/ P25CS205C/ P25ET205C/P25MD205C / P25MP205C	**L**	**T**	**P**	**Credits**
	3	--	--	3

Pre-Requisite: Pre-Requisite: Engineering Mathematics, Engineering Physics, Engineering Mechanics

Course Objectives: The course aims to:

1. Understand fundamentals of project management including project life cycle, stakeholders, and organizational structures.
2. Develop planning and scheduling skills using tools like WBS, CPM, and PERT.
3. Apply cost, quality, risk, and resource management techniques for effective project execution.
4. Enhance decision-making and leadership skills required for monitoring, controlling, and successful project completion.

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

CO	Course Outcomes	Bloom's Level
CO1	Explain project management concepts, project life cycle, and roles of stakeholders.	**U**
CO2	Prepare project plans using scheduling and network techniques such as CPM and PERT.	**A**
CO3	Analyze project costs, risks, quality, and resources for effective control.	**AN**
CO4	Evaluate project performance and apply modern tools for successful project closure. *m's*	**E**

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

CO-PO Mapping:

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

Course Content		
Unit No.	**Description**	**Hrs**
1	**Introduction to Project Management** Definition of project and project management, Characteristics of a project, Project life cycle phases, Project vs operations, Role of project manager, Project stakeholders, Project organization structures (functional, matrix, projectized)	07
2	**Project Identification and Selection** Project identification methods, Feasibility study (technical, economic, financial, social), Project selection techniques, Cost–benefit analysis, Project charter, Project scope definition, Work Breakdown Structure (WBS)	07
3	**Project Planning and Scheduling** Project planning process, Bar charts and milestone charts, Network techniques, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Time estimation, Float and slack analysis.	07
4	**Project Cost and Resource Management** Project cost estimation techniques, Budgeting and cost control, Earned Value Analysis (EVA), Resource planning and allocation, Resource leveling, Project procurement management.	07
5	**Project Risk and Quality Management** Concept of project risk, Risk identification and classification, Risk analysis (qualitative and quantitative), Risk mitigation strategies, Quality planning and assurance, Total Quality Management (TQM), Six Sigma concepts in projects.	07
6	**Project Monitoring, Control, and Closure** Project monitoring techniques, Performance measurement, Project control systems Project communication management, Project documentation, Project audit Project termination and closure, Introduction to project management software (MS Project)	07

Text Books:

1. K.K. Chitkara, *Project Management: Planning, Implementation and Control*, Tata McGraw-Hill Education.
2. P. K. Ghosh, *Project Management*, Oxford University Press.
3. Prasanna Chandra, *Projects: Planning, Analysis, Selection, Implementation and Review*, Tata McGraw-Hill.

Reference Books :

1. Harold Kerzner, *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, Wiley Publications.
2. Jack R. Meredith & Samuel J. Mantel Jr., *Project Management: A Managerial Approach*, Wiley India.
3. Gray, Clifford & Larson, *Project Management: The Managerial Process*, McGraw-Hill Education.

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Title of the Course Name: Health Care Engineering **Course Code:** P25CM205D/ P25CS205D/ P25ET205D/P25MD205D / P25MP205D	**L**	**T**	**P**	**Credits**
	3	--	--	3

Pre-Requisite: Basic understanding of human biology & healthcare terminology, Foundational knowledge in probability, statistics, and operations research Familiarity with optimization techniques and queuing theory, Introductory exposure to programming (Python/MATLAB) and simulation modeling

Course Objectives: The course aims:

1. To understand how the healthcare system works and what challenges it faces.
2. To learn how to improve hospital services using planning and optimization methods.
3. To study how patient waiting lines and hospital processes can be modeled and improved.
4. To explore new technologies like AI, remote care, and digital tools in future healthcare.

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

CO	Course Outcomes	Bloom's Level
CO1	Recall fundamental components of healthcare systems, including resource planning, queuing models, data flows, and innovations in digital health.	R
CO2	Interpret and formulate mathematical models for workforce optimization, facility layout, patient queuing, and healthcare delivery systems	U
CO3	Apply optimization, queuing theory, and simulation methods to enhance healthcare system efficiency, throughput, and patient experience.	A
CO4	Evaluate emerging healthcare technologies and simulation outcomes to improve clinical operations, policy design, and access to quality care.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

	Course Contents	
Unit No.	**Contents**	**Hours**
1	**Introduction to Healthcare System** **Introduction:** Facets of a Healthcare System, Size of a Healthcare System, Health Insurance and Financing, Healthcare Services, Healthcare Ecosystem, Healthcare System Challenges, Access to Healthcare, Healthcare Systems Engineering, **Understanding Delivery: Data and Processes:** Types of Healthcare Data, National Datasets, Healthcare Delivery Process Data, Process Throughput	**7**
2	**Healthcare Resource Workforce and Access to Care Optimization** **Workforce:** Optimization, Supply-Demand Matching, Assignment Models **Optimization** : Facility Optimization, Developing Facility Layout to Minimize Travel Wastage, Considering Multiple Conflicting Objectives, Optimization using a Modeling Language	**6**
3	**Modeling Patient Queues** Kendall's Notation for Queuing Systems, Little's Law, Markovian Queuing Models: M/M/1, M/G/1 Queuing Model, Modeling Interconnected Services using Queuing Networks,	**6**
4	**Healthcare System Simulation** Building a Simulation Study Framework, Event Calendars in Discrete Event Simulation, Input Modeling in Simulation, Output Analysis in Simulation, Estimation in a Non-Terminating, Non-Stationary System: Emergency Department, Simulation of a Hospital Queuing Network	**7**
5	**Future of Healthcare** Shifting from Volume to Value, Evidence-Based Medicine, Personalized Medicine, Vision of the Future, Connected Medicine, **Disease and Condition Management:** Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantable, Digital Health and Therapeutics, AI, Conversational AI, **Making and rationalizing decisions:** Drug discovery, 3-D printing, Personalized prosthetics, Bioprinting and tissue engineering, Pharmacology and devices, Education, Gene therapy, Virtual and Augmented Reality, Merged Reality, Pain Management, Physical Therapy, Nursing and Delivery of Medicine, Virtual Appointments and Classrooms, Blockchain, Patient Record Access., Applications of AI in Healthcare	**10**

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Text Books: 1. Sanjay Mehrotra, Kevin Bui, "Healthcare Engineering", Springer, 1st edition, 2022. 2. Arjun Panesar, "Machine Learning and AI for Healthcare", Apress, 1st edition, 2019.
Reference Books: 1. S. M. Dehkordi, L. Monsef, T. Huschka, *Healthcare Systems Engineering*, Springer, 1st Edition 2. Dinesh Kumar, *Health Systems: Planning, Organization and Management*, Oxford University Press, 1st Edition 3. Paul M. Griffin (Ed.), *Healthcare Systems Engineering*, Wiley, 1st Edition

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Value Enhancement Course

Title of the Course Name: Technologies for Industrial Evolution Course Code: P25CM206/ P25CS206/ P25ET206/ P25MD206/P25MP206	L	T	P	Credits
	2		--	2

Pre-Requisite: Knowledge of Automation, IoT and Industrial Engineering

Course Objectives: The course aims:

1. To understand the historical context, need, and driving factors behind the evolution from Industry 1.0 to Industry 4.0.
2. To introduce the core technologies of Industry 4.0 including IIoT, CPS, smart sensors, and intelligent computing.
3. To familiarize students with digital transformation tools such as AI, cloud computing, and blockchain in the industrial context.
4. To explore smart manufacturing concepts, predictive maintenance strategies, and emerging sustainable trends.

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

CO	Course Outcomes	Bloom's Level
CO1	Describe the historical industrial revolutions and compare the characteristics of Industry 3.0 and 4.0.	U
CO2	Identify and explain the roles of core Industry 4.0 technologies such as IIoT, CPS, and edge/fog computing.	U
CO3	Apply digital tools like AI, big data, and blockchain in industrial problem-solving scenarios.	A
CO4	Analyze smart manufacturing systems, digital twins, and predict future trends in sustainable industrial development.	AN

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Industrial Evolution** Historical Industrial Revolutions, Key Drivers of Industry 4.0, Comparison of Industry 3.0 and 4.0, Global Trends and Indian Scenario.	**6**
2	**Core Technologies in Industry 4.0** IIoT, Smart Sensors, Embedded Systems, Cyber Physical Systems (CPS), Edge and Fog Computing.	**6**
3	**Digital Transformation Tools** Cloud Computing, Big Data Analytics, AI & Machine Learning for Industry, Blockchain in Supply Chain.	**6**
4	**Automation and Smart Manufacturing** Additive Manufacturing, Smart Factories, Industrial Robotics, Human-Machine Collaboration.	**6**
5	**Predictive Maintenance and Digital Twin** Condition Monitoring, Real-time Data Acquisition, Digital Twin Modeling, Fault Diagnosis.	**6**
6	**Future Trends and Case Studies** Green Manufacturing, Sustainable Technologies, 5G for Industry, Case Studies on Digital Transformation.	**6**

Text Books:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press.
2. Sabina Jeschke et al., Industrial Internet of Things: Cyber manufacturing Systems, Springer.
3. Brettel M. – How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective.

Reference Books:

1. Klaus Schwab – The Fourth Industrial Revolution, World Economic Forum.
2. Jay Lee – Smart Manufacturing, Springer.
3. Andrew Ng – Machine Learning Yearning, DeepLearning.ai (for AI relevance).

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Experiential Learning Course

Title of the Course Name: Mini Project Course Code: P25ET207	L	T	P	Credits
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Pre-Requisite:

- Basic and advanced knowledge of Digital Signal Processing, Embedded Systems, Communication Systems, or VLSI Design (as applicable to project area)
- Programming proficiency in MATLAB, Python, or embedded C
- Fundamentals of system design, circuit simulation, and analytical skills
- Familiarity with research methodology and technical report writing

Course Objectives: The course aims:

1. To identify and analyze engineering problems relevant to the Electronics and Telecommunication (E&TC) domain using foundational concepts.
2. To apply theoretical knowledge and engineering tools for the design, simulation, and implementation of electronic systems.
3. To foster self-directed learning, teamwork, and project management in a multidisciplinary engineering environment.
4. To build effective communication skills through documentation, report writing, and technical presentations.

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

CO	Course Outcomes	Bloom's Level
CO1	Identify and analyze real-world engineering problems using domain-specific knowledge.	AN
CO2	Design and implement electronic systems or subsystems using appropriate simulation tools and hardware platforms.	C
CO3	Demonstrate effective teamwork and project management in completing assigned tasks within deadlines.	E
CO4	Prepare well-structured technical reports and deliver oral presentations with clarity and professionalism.	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Sr.No.	Guidlines
1	**Activities involved:** 1. Mini project should be undertaken individually. 2. Topic should be relevant to E&TC with focus on problem solving, innovation, or application 3. A detailed proposal should be submitted with problem statement, objectives, methodology, and timeline 4. Regular progress reviews should be conducted (at least two internal reviews) 5. Implementation can be software-based (MATLAB, Python, LabVIEW) or hardware-based (using DSP/FPGA/Embedded kits) 6. Emphasis should be placed on originality, practical relevance, and feasibility 7. Maintain a project logbook detailing weekly progress, issues faced, and resolutions 8. Final submission must include a well-structured report, simulation/implementation files, and presentation 9. Viva-voce will be conducted to assess individual contribution and understanding
2	**Format for Report (Spiral Bound & Soft Copy)** 1. Cover Page 2. Certificate (Guide + Head of Department) 3. Declaration 4. Acknowledgement 5. Abstract 6. Table of Contents 7. List of Figures/Tables (if applicable) 8. Chapters: o Introduction o Literature Review o Problem Statement o Objectives o System Design and Methodologies o Implementation and Testing o Results and Discussions o Conclusion and Future Work 9. References (IEEE format) 10. Appendix (if applicable)
3	**Deliverables** • **Mini Project Proposal** (hard copy & soft copy – before implementation begins) • **Weekly Progress Logbook** signed by the guide • **Final Project Report** in hard copy and PDF (as per the given format) • **Working Model/Simulation Output** (if applicable)

	• **Presentation Slides (PPT)** • **Final Viva & Demonstration** before PRC • **Source Code/Design Files** on CD/pen drive or shared via link

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Experiential Learning Course

Title of the Course Name: PG Lab-II Course Code: P25ET208	L	T	P	Credits	
	--	--	04	2	

Part-I: Advanced Embedded System Lab

Pre-Requisite: Basic understanding of microcontrollers, embedded C programming, digital electronics, and interfacing techniques.

Course Objectives: The course aims:

1. To interface and program ARM Cortex-M-based systems using STM32.
2. To integrate sensors, actuators, and communication modules with microcontrollers.
3. To design, simulate, and debug embedded applications using STM32CubeIDE or Keil µVision.

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

CO	Course Outcomes	Bloom's Level
CO1	Develop programs using GPIOs	A
CO2	Interface peripherals using serial communication protocols (UART, SPI, I2C)	A
CO3	Design and test real-time embedded applications with peripherals	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

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Course Content		
Experiment No.	**Experiment Title**	**Hrs**
1	Interfacing of digital output devices with GPIO(LED)	2
2	Interfacing of digital Input devices with GPIO(Keyboard/switch)	2
3	Generation of PWM for LED dimming or motor speed control	2
4	Interfacing of ADC-based analog sensor (e.g., potentiometer, LM35)	2
5	Generation of DAC output waveform using STM32	2
6	Interfacing of I2C with RTC or temperature sensor (e.g., DS1307/LM75)	2
7	Application development: Digital thermometer with LCD/serial output	2
8	Case study: Data logger using SD card and RTC	2

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Part-II: Image Processing and Computer Vision Lab

Pre-Requisite: Fundamental DSP concepts, Z-transform, Fourier analysis, and digital filter design. Basic proficiency in MATLAB or Python.

Course Objectives: The course aims:

1. To explore and implement advanced concepts in digital signal processing through practical experiments.
2. To strengthen the analytical and computational skills required for filter design, spectral analysis, and adaptive systems.
3. To gain experience with multirate signal processing, time-frequency methods, and real-time signal applications.
4. To build competence in applying DSP techniques to modern communication and multimedia systems.

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

CO	Course Outcomes	Bloom's Level
CO1	Perform basic operations such as image reading, displaying, and transformation.	A
CO2	Apply filtering techniques for image smoothing and sharpening.	A
CO3	Implement histogram equalization and enhancement techniques for image quality improvement.	A,AN
CO4	Apply edge detection and morphological operations for object segmentation.	A
CO5	Apply basic computer vision methods like feature detection and object recognition	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Experiment No.	**Experiment Title**	**Hrs**
1	Read, display, and convert images to grayscale and binary formats.	2
2	Perform image negative, log, and power-law transformations.	2
3	Apply image smoothing using mean and Gaussian filters.	2
4	Perform image sharpening using Laplacian and high-boost filters.	2
5	Implement histogram equalization for image contrast enhancement.	2
6	Detect edges using Sobel, Prewitt, and Canny operators.	2
7	Apply morphological operations such as erosion, dilation, opening, and closing.	2
8	Segment objects in an image using thresholding and contour detection.	2
9	Detect features using Harris corner detector and SIFT or ORB.	2
10	Recognize simple objects or shapes in an image using template matching.	2

Note: *Minimum 08 experiments to be performed.

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Experiential Learning Course

Title of the Course Name: Internship/Training Course Code: P25ET209	L	T	P	Credits
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Pre-Requisite:

- Completion of core PG coursework in Electronics and Telecommunication
- Basic technical and communication skills
- Awareness of industrial tools, platforms, or technologies relevant to the chosen domain
- Readiness for professional work ethics and environment
- Resume and basic documentation (cover letter, academic transcripts)

Course Objectives: The course aims:

1. To bridge the gap between academic learning and industry practices
2. To expose students to real-world engineering environments and team collaboration
3. To develop domain-specific technical skills through hands-on experience
4. To enhance understanding of project workflows, timelines, and industrial tools
5. To build professional and interpersonal communication skills
6. To enable understanding of innovation, standards, and regulatory practices in industry.

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

CO	Course Outcomes	Bloom's Level
CO1	Identify industrial problems relevant to their field of specialization	U
CO2	Demonstrate technical and professional skills acquired during the internship	A
CO3	Analyze industrial processes and workflows	AN
CO4	Evaluate the role of engineering knowledge in solving practical problems	E
CO5	Develop industry-oriented solutions or contributions to assigned tasks	C
CO6	Prepare and present a professional internship report	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Sr.No.	Guidelines
1	**Activities Involved** 1. Identifying and applying to companies or R&D organizations 2. Completion of internship spanning 4 weeks 3. Hands-on work under assigned industry mentors 4. Weekly task updates and feedback sessions 5. Final presentation and submission of training report
2	**Requirements** • Internship should be in a core or allied domain: Telecom, Embedded, Signal Processing, Networking, VLSI, IoT, AI, etc. • Prior approval must be taken from the Internship/Training Coordinator • Maintain a **daily logbook** recording work done, observations, and reflections • Internship certificate must be obtained from the industry at the end of the training • Students are required to submit: a) Internship Completion Certificate b) Internship Report (format below) c) Logbook or Weekly Activity Sheet d) Presentation and Viva before Evaluation Panel.
3	**Internship Report Format (Hard bound Copy)** 1. **Cover Page** (Institute, Title, Student Name, Industry Name, Duration) 2. **Certificate from Institute** 3. **Certificate from Company** 4. **Acknowledgment** 5. **Table of Contents** 6. **Chapter 1: Introduction** – Overview of the organization and objectives 7. **Chapter 2: Training Activities** – Tasks performed, tools used, departments visited 8. **Chapter 3: Technical Learning** – Concepts, skills, technologies learned 9. **Chapter 4: Analysis and Outcomes** – Contributions made, learnings, challenges 10. **Chapter 5: Conclusion** – Summary and future scope 11. **References** (if applicable) 12. **Appendices** – Screenshots, tools used, code samples (if allowed)

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Semester: III

Open Elective-II

Course Code	Course Name (OE)
P25ET301A	Labour Welfare and Industrial Relations
P25ET301B	Sustainable Technology
P25ET301C	Entrepreneurship Development
P25ET301D	Industrial Automation

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Title of the Course Name: Labour Welfare and Industrial Relations Course Code: P25CM301A/ P25CS301A/ P25ET301A/ P25MD301A / P25MP301A	L	T	P	Credits
	3	--	--	3

Pre-Requisite: Fundamentals of Human Resource Management, Basics of Organizational Behaviour, Indian Labour Laws (basic awareness preferred)

Course Objectives: The course aims:

1. Provide an in-depth understanding of labour welfare concepts and principles.
2. Study the evolution and framework of industrial relations in India.
3. Analyze the role of trade unions, collective bargaining, and dispute resolution mechanisms.
4. Evaluate labour policies, legislation, and welfare measures with real-world applications.

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

CO	Course Outcomes	Bloom's Level
CO1	Define and explain the concepts of labour welfare and industrial relations.	R
CO2	Analyze the role of trade unions, employee participation, and dispute resolution mechanisms.	AN
CO3	Examine labour laws and welfare measures applicable in industrial settings.	AN
CO4	Evaluate the effectiveness of industrial relations strategies in promoting harmony and productivity.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Labour Welfare:** Concept of labour welfare and its importance, Principles and types of labour welfare, Role of the government and employers in labour welfare, Statutory and non-statutory welfare measures	**6**
2	**Industrial Relations Framework:** Evolution and scope of industrial relations, Objectives and importance of industrial relations, Approaches to industrial relations, Role of stakeholders (government, employers, employees)	**6**
3	**Trade Unions in India:** Trade unions: concept, structure, and functions, Growth of trade union movement in India, Trade union legislation, Role of trade unions in industrial relations, Challenges faced by trade unions	**6**
4	**Collective Bargaining and Employee Participation:** Concept and process of collective bargaining, Types and importance of collective bargaining, Workers' participation in management, Joint management councils, Works committees	**6**
5	**Industrial Disputes and Resolution Mechanisms:** Causes and effects of industrial disputes, Methods of dispute resolution (conciliation, arbitration, adjudication), Role of grievance redressal systems, Disciplinary procedures	**6**
6	**Labour Legislation and Contemporary Issues:** Overview of key labour laws (Factories Act, Trade Unions Act, Industrial Disputes Act), Recent changes in Indian labour codes, Case studies on labour welfare and industrial relations, Emerging trends and challenges	**6**

Text Books:

1. **Sinha, P.R.N., Sinha, I.B., and Shekhar, S.P.** – *Industrial Relations, Trade Unions, and Labour Legislation*, Pearson Education
2. **Mamoria, C.B. and Mamoria, S.** – *Dynamics of Industrial Relations*, Himalaya Publishing House

Reference Books:

1. **Monappa A., Nambudiri R. & Selvaraj, P.** – *Industrial Relations and Labour Laws*, 2nd Edition ,McGraw Hill
2. **Srivastava, S.C.** – *Industrial Relations and Labour Laws*, Vikas Publishing
3. **Indian Labour Codes & Government Publications** – Ministry of Labour and Employment

MOOC/NPTEL Platform:

1. **NPTEL: https://onlinecourses.nptel.ac.in/noc25_mg159/preview**

Title of the Course Name: Sustainable Technology	**L**	**T**	**P**	**Credits**
Course Code: P25CM301B/ P25CS301B/ P25ET301B/ P25MD301B/ P25MP301B	3	--	--	3

Pre-Requisite: Basic knowledge of science, environment, and technological applications, Awareness of current environmental challenges and sustainability needs

Course Objectives: The course aims:

1. To introduce the concepts and principles of sustainable development and technology.
2. To evaluate the impact of current technologies on environmental, social, and economic systems.
3. To explore clean and green technologies that promote sustainability.
4. To enable students to design or adopt sustainable solutions for real-world applications.

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

CO	Course Outcomes	Bloom's Level
CO1	Explain the core principles of sustainability and sustainable development	U
CO2	Analyze various sustainable technologies in energy, water, and waste sectors	A
CO3	Evaluate lifecycle and environmental impact of a given technology	E
CO4	Propose sustainable technology solutions for specific local/global issues	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Introduction to Sustainable Development and Technology:** Sustainability principles, triple bottom line, SDGs, environmental degradation, ecological footprint, carbon emissions, circular economy	**6**
2	**Sustainable Energy Technologies:** Renewable energy sources, solar PV, wind, hydropower, biomass, green hydrogen, energy efficiency, smart grids	**6**
3	**Sustainable Water and Sanitation Technologies:** Rainwater harvesting, water purification technologies, wastewater treatment, greywater recycling, low-flow devices, SDG 6 focus	**6**
4	**Sustainable Waste Management:** Waste hierarchy (Reduce-Reuse-Recycle), e-waste, composting, biodegradable packaging, plastic alternatives, waste-to-energy	**6**
5	**Green Building and Smart Infrastructure:** Energy-efficient building materials, passive solar design, green rating systems (LEED, GRIHA), smart cities, sustainable transportation	**6**
6	**Life Cycle Assessment and Sustainable Innovation:** LCA tools and methods, carbon footprint tools, eco-design, green product innovation, sustainable entrepreneurship, case studies	**6**

Text Books:

1. Sustainable Engineering: Concepts, Design and Case Studies – D. Allen, D. Shonnard
2. Sustainability Principles and Practice – Margaret Robertson

Reference Books:

1. Green Technologies and Environmental Sustainability – R. Raveendran
2. Reports from UNEP, NITI Aayog, MoEFCC

MOOC/NPTEL Platform:

1. **NPTEL:** Sustainable Engineering Concepts and Life Cycle by By Prof. Brajesh Kumar Dubey, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc25_ce117/preview

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Title of the Course Name: Entrepreneurship Development Course Code: P25CM301C/ P25CS301C/ P25ET301C/ P25MD301C/ P25MP301C	L	T	P	Credits
	3	--	--	3

Pre-Requisite: Basics of Management, Market Research Fundamentals, Financial Accounting Basics.

Course Objectives: The course aims:

1. To introduce the fundamental concepts and evolution of entrepreneurship, including the role of creativity and innovation.
2. To enable students to recognize business opportunities and develop viable business models using structured techniques.
3. To equip students with knowledge of business planning, financial feasibility, legal structures, and institutional support for startups.
4. To explore funding strategies, growth management, and emerging trends in entrepreneurship and intrapreneurship.

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

CO	Course Outcomes	Bloom's Level
CO1	Explain the concepts, types, and evolution of entrepreneurship along with the importance of innovation.	U
CO2	Apply opportunity recognition and business modeling techniques like BMC and lean startup.	A
CO3	Analyze the feasibility of a business idea considering financial, legal, and institutional frameworks.	AN
CO4	Evaluate different funding options and growth strategies, including emerging trends in entrepreneurship.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Fundamentals of Entrepreneurship** Definition, types and evolution of entrepreneurship, Entrepreneur vs intrapreneur, Importance of creativity and innovation in venture creation.	**6**
2	**Opportunity Recognition & Business Models** Idea generation techniques - brainstorming, TRIZ, SCAMPER, Market research and feasibility analysis, Business Model Canvas and lean startup methodology.	**6**
3	**Business Planning and Project Feasibility** Components of a business plan, Cost–benefit analysis - NPV, IRR, ROI, Financial planning, budgeting, cost structures.	**6**
4	**Legal & Institutional Framework** Business entity types - sole proprietorship, LLP, Pvt. Ltd, Registration processes, IPR fundamentals - patents, trademarks, Schemes and support - Start-up India, SIDBI, NABARD.	**6**
5	**Financing and Growth Management** Funding sources - bootstrapping, angel investors, VC, loans, Scaling strategies, growth stages, risk management, Role of incubation, accelerators, and mentorship.	**6**
6	**Emerging Entrepreneurship Trends** Social, rural, digital entrepreneurship, Corporate intrapreneurship dynamics, Technology-driven ventures and ecosystem trends.	**6**

Text Books:

1. Engineering Entrepreneurship: From Idea to Business Plan – Paul Swamidass, Cambridge University Press, 2015.
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Crown Business, 2011.
3. Entrepreneurship Development, S. Anil Kumar, Scientific Publishers, 2019.

Reference Books:

1. Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Bill Aulet, Wiley, 2013.
2. Opportunity Recognition in Entrepreneurial Teams, Maureen McKelvey, Per Davidsson, Leif Wennberg, Springer, 2021.
3. Effectuation: Elements of Entrepreneurial Expertise, Saras D. Sarasvathy, Edward Elgar, 2008, 2nd ed. 2021.

Title of the Course Name: Industrial Automation Course Code: P25CM301D/ P25CS301D/ P25ET301D/ P25MD301D/ P25MP301D	L	T	P	Credits
	3	--	--	3

Pre-Requisite: Electrical Networks and Control, Digital Electronics Basics.

Course Objectives: The course aims:

1. To familiarize students with the hierarchical structure of industrial automation systems and various sensing technologies used in the industry.
2. To impart knowledge of process control systems and tuning techniques including PID controllers and advanced control methods.
3. To train students in PLC programming, sequential control, and industrial networking protocols for automation.
4. To introduce advanced automation technologies including IIoT, CNC, robotics, and cyber-secure smart manufacturing systems.

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

CO	Course Outcomes	Bloom's Level
CO1	Explain the structure of industrial automation systems and describe the working principles of common industrial sensors and actuators.	U
CO2	Apply PID tuning techniques to control processes using feedback loops, cascade control, and feed-forward methods.	A
CO3	Develop ladder and structured text programs for automation using PLCs and integrate industrial communication protocols (e.g., Modbus, Profibus).	A
CO4	Analyze and evaluate the integration of advanced automation systems like SCADA, IIoT, and robotics for Industry 4.0 implementations.	AN,E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Architecture and Sensing in Industrial Automation** Overview of Automation Systems - Architecture, CPS, levels of automation, discrete vs process systems, Industrial Sensors and Signal Conditioning - Temperature, pressure, displacement, flow, force sensors; calibration, error analysis and conditioning circuits.	**6**
2	**Process Control and PID Techniques** Fundamentals of Control Systems - Feedback loops, stability, controller types, PID Controllers - P/PI/PID tuning methods Ziegler–Nichols, feed-forward, cascade, predictive control.	**6**
3	**Sequence Control and PLC Programming** Components of a business plan, PLC Basics - Hardware architecture, scan cycle, I/O interfacing, Programming in Ladder and Structured Control - Relay logic, timers, counter blocks, structured design.	**6**
4	**Fieldbus Protocols, SCADA and DCS** Industrial Communication Networks -Modbus, Profibus, HART, Fieldbus, Ethernet/IP, SCADA/DCS Architecture and HMI - Data acquisition, historian logs, alarms, cyber security, OPC UA.	**6**
5	**Actuators and Drive Systems** Actuator Technologies - Hydraulic, pneumatic valves, electric drives, stepper and servo motors, Drive Systems and VFDs - Variable frequency drives, speed control, energy-efficient operation.	**6**
6	**Advanced Automation and Industry 4.0 Integration** CNC & Robotics Basics - Machine tool control loops, robotic manipulators, grippers, kinematics, IIoT, Analytics and Cyber security - Edge computing, data analytics, smart manufacturing and automation system security.	**6**

Text Books:

1. Industrial Automation: Hands-On, Frank Lamb, McGraw-Hill, 1st ed., 2013
2. Industrial Automation Solutions for PLC, SCADA, Drive and Field Instruments – Sanjay B. Katariya, Notion Press, 2020..

Reference Books:

1. Standard Handbook of Industrial Automation – Douglas M. Considine & Glenn D. Considine, Springer, 1st ed., 1987.
2. Instrumentation for Process Measurement and Control – Norman A. Anderson, Chilton Company, 3rd ed., Circa 1990.
3. Industrial Automation from Scratch, Olushola Akande, Packt Publishing, 2023.

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MULTIDISCIPLINARY MINOR (MDM)

Title of the Course Name: IoT and its Applications **Course Code:**P25ET302	**L**	**T**	**P**	**Credits**
	3	--	--	3

Pre-Requisite: Basic knowledge of electronics, embedded systems and computer networking

Course Objectives: The course aims:

1. To introduce the foundational concepts, architecture, and enabling technologies of the Internet of Things (IoT).
2. To develop understanding of sensor networks, wireless protocols, and IP-based communication in IoT systems.
3. To provide insight into data acquisition, storage, analytics, and cloud computing platforms relevant to IoT.
4. To explore real-world applications of IoT across domains and address associated ethical and legal considerations.

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

CO	Course Outcomes	Bloom's Level
CO1	Describe the structure, components, and communication architecture of IoT systems.	U
CO2	Compare and apply various wireless technologies and IP-based protocols for IoT applications.	AN,A
CO3	Implement basic IoT solutions using development platforms and interface them with cloud services for data logging and visualization.	A
CO4	Evaluate the potential of IoT in sectors such as healthcare, agriculture, industry, and smart cities considering ethical and legal implications.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Course Content		
Unit No.	**Contents**	**Hrs**
1	**Fundamentals of IoT** Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M	**6**
2	**Sensors Networks** Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT	**6**
3	**Wireless Technologies for IoT** WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. **IP Based Protocols for IoT** IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols	**6**
4	**Data Handling& Analytics** Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications	**6**
5	**Cloud computation** Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Interfacing and data logging with cloud: Blync, Thing speak, platforms	**6**
6	**Applications of IoT** Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection	**6**

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Text Books:

1. Adrian Mcewen, HakinCassimally, Designing The Internet of Things, First Edition, Wiley
2. The Internet of Things: Enabling Technologies and Solutions for Design and Test, Application Note, 2016.
3. Vijay Madisetti, ArshdeepBahga, Internet of Things A Hands-On- Approach

Reference Books:

1. Raj Kamal, Internet of Things: Architecture and Design, McGraw Hill.2nd edition June 2022
2. Pethuru Raj, Anupama C. Raman, The Internet of Things Enabling Technologies, Platforms, and Use Cases, Taylor and Francis group. February 2017
3. Peter Waher, Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3, First Edition, Packt Publishing, 2018

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Title of the Course Name: Artificial Intelligence & Machine Learning Course Code: P25CS302	L	T	P	Credits
	3	--	--	3

Pre-Requisite:-

Course Objectives: The course aims:
1. Apply AI techniques to solve the given problems.
2. Implement trivial AI techniques on relatively large system
3. Explain uncertainty and Problem-solving techniques.
4. compare various learning techniques.

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

Course Outcomes	
CO1	Identify and analyze AI-based problems
CO2	Apply appropriate techniques and advanced search methods
CO3	Discuss and apply various learning techniques
CO4	Design expert systems

Course Content		
Unit No.	**Content**	**Hrs**
1	**Introduction to AI** Basic Concepts of AI and State space search, Introduction to unguided and guided search	**6**
2	**Heuristic Search and Intelligent Learning Methods** Problems in search and solutions, Genetic algorithms, Neural Networks, BPNN, learning process in BPNN	**6**
3	**Advanced Search, Planning, and Problem Solving** Some other search methods and Admissibility, Planning, Game Playing	**6**
4	**Game Playing and Knowledge Representation** Minimax and other game playing algorithms , using predicate logic for Knowledge Representation	**6**
5	**Advanced Knowledge Representation and Reasoning** Resolution and non-monotonic reasoning, Strong methods for knowledge representation, Fuzzy logic and certainty factors (CD)	**6**
6	**Expert Systems and Machine Learning Concepts** Scripts and introduction to expert systems, Developing expert systems, Basics of machine learning	**6**

Text books:

1. Stuart J. Russell, Peter Norvig , Artificial Intelligence: A Modern Approach, Pearson, 4th edition, 2021.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, McGraw Hill Education, 3rd edition, 2017.

Reference books:

1. **Elaine Rich, Kevin Knight, Shivashankar B. Nair**, Artificial Intelligence, McGraw Hill Education, 3rd edition (Indian Adaptation), 2019.
2. **Wolfgang Ertel**, Introduction to Artificial Intelligence, Springer, 2nd edition, 2017.
3. **Saroj Kaushik**, Artificial Intelligence, Cengage Learning India, Revised edition, 2020.

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Experiential Learning Course

Title of the Course Name: Dissertation Phase-I Course Code: P25ET303	L	T	P	Credits
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Pre-Requisite:

- Understanding of core and elective subjects related to the chosen domain.
- Familiarity with research methodology, academic writing, and referencing.
- Knowledge of simulation tools, programming platforms, or hardware (as required by the topic).

Course Objectives: The course aims:

1. To identify a research problem relevant to Electronics and Telecommunication Engineering.
2. To conduct an in-depth literature survey and identify research gaps.
3. To formulate objectives, scope, and methodology of the proposed work.
4. To enhance research planning, time management, and technical writing skills.

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

CO	Course Outcomes	Bloom's Level
CO1	Identify and define a research problem with appropriate scope and relevance.	AN
CO2	Conduct a comprehensive literature survey and identify research gaps.	AN
CO3	Formulate problem statements, objectives, and methodology.	C
CO4	Prepare and present a project proposal with justification and expected outcomes.	A
CO5	Demonstrate the ability to document and present research progress professionally	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Sr.No.	Guidlines
1	**Activities Involved** 1. Selection of a relevant research topic in consultation with a guide. 2. Literature review using journals, conference papers, patents, and technical reports. 3. Identification of research gaps, problem statement formulation. 4. Planning of methodology, tools, datasets, and experimental setup (if applicable). 5. Partial implementation or simulation (as feasible). 6. Periodic presentations and documentation.
2	**Format for Report (Spiral Bound & Soft Copy)** 11. Cover Page 12. Certificate (Guide + Head of Department) 13. Declaration 14. Acknowledgement 15. Abstract 16. Table of Contents 17. List of Figures/Tables (if applicable) 18. Chapters: o Introduction o Literature Review o Problem Statement o Objectives o Proposed Methodology o Preliminary Work Done o Conclusion and Future Work 19. References (IEEE format) 20. Appendix (if applicable)
3	**Deliverables** • Synopsis (approved by guide and PRC). • Interim progress report. • Final report of Dissertation Phase–I. • Presentation and viva before the department PRC.

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Semester: IV
Experiential Learning Course

Title of the Course Name: Dissertation Phase-II **Course Code:** P25ET401	**L**	**T**	**P**	**Credits**
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Pre-Requisite:

- Completion of Dissertation Phase–I with approved synopsis and partial implementation.
- Working knowledge of design tools, simulation software, or experimental hardware platforms.
- Familiarity with academic writing, plagiarism policies, and peer-reviewed publishing process.

Course Objectives: The course aims:

1. To implement the proposed methodology as outlined in Dissertation Phase–I.
2. To carry out rigorous experimentation, simulation, or design and analyze the results.
3. To interpret outcomes with reference to existing research and identify their impact.
4. To prepare and submit a complete dissertation report adhering to academic standards.
5. To demonstrate technical knowledge, communication skills, and research aptitude through presentation and publications.

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

CO	Course Outcomes	Bloom's Level
CO1	Apply the proposed design or methodology effectively using relevant tools and techniques.	A
CO2	Analyze experimental or simulation results critically to draw meaningful conclusions.	AN
CO3	Demonstrate innovation and problem-solving skills in the chosen domain.	C
CO4	Publish research findings in reputed journals or conferences.	A
CO5	Compile and submit a comprehensive dissertation report with complete documentation.	A
CO6	Defend the dissertation work confidently during final viva-voce.	E

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Sr.No.	Guidlines
1	**Activities Involved** 1. Full implementation of the system/methodology. 2. Conduct simulations, hardware experiments, or data analysis. 3. Compare results with existing methods or baseline systems. 4. Write and submit research papers to suitable conferences or journals. 5. Prepare the final dissertation report. 6. Final seminar and viva-voce before internal and external examiners.
2	**Mandatory Paper Publication Requirements** • Each student must publish **a minimum of two research papers** based on their dissertation work **before submission**. • The papers must be: o **At least one in a SCI/ SCIE/ SCOPUS/ Web of Science/ Peer-Reviewed Journal.** o **The second can be in a national/international conference with review and proceedings.** • Proof of **acceptance or publication** must be submitted along with the final dissertation. • Co-authorship with guide or peer students is acceptable, but the student must be the primary contributor.
3	**Report Format (Hardbound Copy)** 1. Cover Page 2. Certificate (Guide, HoD, External Examiner) 3. Declaration 4. Acknowledgement 5. Abstract 6. Table of Contents 7. List of Figures and Tables 8. Chapters: o Introduction o Literature Review o Gap Identification o Problem Statement o Objectives o Methodology o Implementation o Results and Discussion o Conclusion and Future Scope 9. References (IEEE format) 10. Appendices (if applicable) 11. Copies of Published Papers (as Annexure)

4	**Deliverables** • **Hardbound final dissertation report** (in prescribed format). • **Soft copy of report and presentation** (PDF and PPT). • **Plagiarism report** (Turnitin/Urkund $\leq 10\%$). • **Proof of 2 paper publications** (acceptance letters/certificates/published copy). • **Source code, design files, datasets** (if applicable). • **Final presentation and viva sheet** signed by the PRC.

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Exit Courses after Semester– II - P.G. Diploma

Title of the Course Name: Employability Skill Development **Course Code:** P25ET210	**L**	**T**	**P**	**Credits**
	4	--	--	4

Pre-Requisite: Basic English communication

Course Objectives: The course aims:

5. To develop effective communication, teamwork, and interpersonal skills
6. To enhance professional readiness through resume building and interview practice
7. To build leadership qualities and critical thinking for workplace adaptability
8. To inculcate ethics, etiquette, and time management in professional settings

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

CO	Course Outcomes	Bloom's Level
CO1	Demonstrate effective communication and interpersonal skills	U,A
CO2	Apply leadership and teamwork principles in professional settings	A
CO3	Prepare resumes and participate effectively in interviews and group discussions	A
CO4	Practice workplace etiquette, time management, and ethical behavior	U,A

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Course Content		
Unit No.	**Contents**	**Hrs**
1	**Communication Skills** Verbal and non-verbal communication, active listening, barriers to communication, clarity and coherence, email and business communication, public speaking, presentation skills	**6**
2	**Personality Development and Interpersonal Skills** Positive attitude, self-confidence, grooming and body language, self-awareness, empathy, emotional intelligence, teamwork and collaboration, conflict resolution	**6**
3	**Resume and Cover Letter Writing** Types of resumes, components of an effective resume, tailoring resumes to job roles, cover letter writing, common errors in resumes, creating a LinkedIn profile	**6**
4	**Interview Preparation and Group Discussion** Types of interviews, interview etiquette, commonly asked questions, STAR technique, mock interviews, types of group discussions, do's and don'ts in GD, communication in a group setting	**6**
5	**Professional Skills and Workplace Etiquette** Workplace behavior, ethics and integrity, corporate etiquette, professionalism, time management, goal setting, stress management, adaptability	**6**
6	**Career Planning and Employability Readiness** Career planning techniques, self-assessment and SWOT analysis, decision-making skills, building confidence, job search strategies, facing challenges in the workplace	**6**

Text Books:

1. Barun K. Mitra , Personality Development and Soft Skills, Oxford University Press
2. Andrews, Sudhir , How to Succeed at Interviews, Tata McGraw Hill

Reference Books:

1. **Dr. K. Alex** – *Soft Skills: Know Yourself & Know the World*, S. Chand
2. **Wallace & Masters** – *Personal Development for Life and Work*, Cengage Learning
3. **Dale Carnegie** – *How to Win Friends and Influence People*, Simon & Schuster
4. NSDC / NASSCOM soft skills modules, National Skill Development Corporation resources.

MOOC/NPTEL Platform:

1. **Developing Soft Skills and Personality** by Prof. T Ravichandran (IIT Kanpur)]
   Link: https://nptel.ac.in/courses/109/104/109104115

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Experiential Learning Course

Title of the Course Name: Internship/Training Course Code: P25ET209	L	T	P	Credits
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Pre-Requisite:

- Completion of core PG coursework in Electronics and Telecommunication
- Basic technical and communication skills
- Awareness of industrial tools, platforms, or technologies relevant to the chosen domain
- Readiness for professional work ethics and environment
- Resume and basic documentation (cover letter, academic transcripts)

Course Objectives: The course aims:

1. To bridge the gap between academic learning and industry practices
2. To expose students to real-world engineering environments and team collaboration
3. To develop domain-specific technical skills through hands-on experience
4. To enhance understanding of project workflows, timelines, and industrial tools
5. To build professional and interpersonal communication skills
6. To enable understanding of innovation, standards, and regulatory practices in industry.

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

CO	Course Outcomes	Bloom's Level
CO1	Identify industrial problems relevant to their field of specialization	U
CO2	Demonstrate technical and professional skills acquired during the internship	A
CO3	Analyze industrial processes and workflows	AN
CO4	Evaluate the role of engineering knowledge in solving practical problems	E
CO5	Develop industry-oriented solutions or contributions to assigned tasks	C
CO6	Prepare and present a professional internship report	C

U=Understand, R=Remember, A=Apply, AN=Analyze, E=Evaluate, C=Create

Sr.No.	Guidelines
1	**Activities Involved** 1. Identifying and applying to companies or R&D organizations 2. Completion of internship spanning 4 weeks 3. Hands-on work under assigned industry mentors 4. Weekly task updates and feedback sessions 5. Final presentation and submission of training report
2	**Requirements** • Internship should be in a core or allied domain: Telecom, Embedded, Signal Processing, Networking, VLSI, IoT, AI, etc. • Prior approval must be taken from the Internship/Training Coordinator • Maintain a **daily logbook** recording work done, observations, and reflections • Internship certificate must be obtained from the industry at the end of the training • Students are required to submit: a) Internship Completion Certificate b) Internship Report (format below) c) Logbook or Weekly Activity Sheet d) Presentation and Viva before Evaluation Panel.
3	**Internship Report Format (Hard bound Copy)** 1. **Cover Page** (Institute, Title, Student Name, Industry Name, Duration) 2. **Certificate from Institute** 3. **Certificate from Company** 4. **Acknowledgment** 5. **Table of Contents** 6. **Chapter 1: Introduction** – Overview of the organization and objectives 7. **Chapter 2: Training Activities** – Tasks performed, tools used, departments visited 8. **Chapter 3: Technical Learning** – Concepts, skills, technologies learned 9. **Chapter 4: Analysis and Outcomes** – Contributions made, learnings, challenges 10. **Chapter 5: Conclusion** – Summary and future scope 11. **References** (if applicable) 12. **Appendices** – Screenshots, tools used, code samples (if allowed)