Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

An Autonomous Institute

Affiliated to DBATU, Lonere (M.S.),

Approved by AICTE, New Delhi and Govt. of Maharashtra

(DTE: EN - 5172)

Accredited by NAAC 'A' Grade, Bangalore.

Course Curriculum Structure

Electronics & Telecommunication Engineering

Final Year B. Tech

Batch: 2020-2024

With Effect from Academic Year 2023-24

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405

www.rcpit.ac.in

Semester-VII (w.e.f. Academic Year 2023-24)												
Sr. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					
							Continuous Assessment (CA)				ESE	Total	Credit
				L	T	P	TA	TT1	TT2	Best of TT1 & TT2		
							A			B	C	A+B+C	
1	PC	PCET7010T	Mobile Communication System	3	--	--	20	15	15	15	65	100	3
2	PC	PCET7010L	Mobile Communication System Lab	--	--	2	25	--	--	--	25	50	1
3	PC	PCET7020T	Microwave Engineering	3	--	--	20	15	15	15	65	100	3
4	PC	PCET7020L	Microwave Engineering Laboratory	--	--	2	25	--	--	--	25	50	1
5	PE	PEET703-T	Professional Elective	3	--	--	20	15	15	15	65	100	3
6	PE	PEET703-L	Professional Elective Laboratory	--	--	2	25	--	--	--	25	50	1
7	OE	OEET704-T	Open Elective	3	--	--	20	15	15	15	65	100	3
8	PC	PCET7050L	IoT and Sensor Network Laboratory	--	--	2	25	--	--	--	25	50	1
9	PC	PCET7060L	Industrial Automation Laboratory	--	--	2	25	--	--	--	25	50	1
10	PJ	PJET7070L	Project Stage-II	--	--	8	25	--	--	--	25	50	4
			Total	**12**	**--**	**18**	**230**	**--**	**--**	**60**	**410**	**700**	**21**

PC: Program Core, **PE:** Program Elective, **OE:** Open Elective, **PJ:** Project, **TA:** Teachers Assessment, **TT1:** Term Test-1, **TT2:** Term Test-2

Prepared By
Bhushan V. Patil

Checked By
Dr. Prashant G Patil

E&TC Department R.C.P.I.T. OFFICE SEAL SHIRPUR

BOS Chairman
Prof.Dr. Vijay S. Patil

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DIRECTOR
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Shirpur Dist Dhule (MS)

Semester-VIII (w.e.f. Academic Year 2023-24)													
Sr. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit
							Continuous Assessment (CA)				ESE		
				L	T	P	TA	TT1	TT2	Best of TT1 & TT2			
							A			B	C	A+B+C	
1	PE	PEET801-T	Professional Elective-1	3	--	--	20	15	15	15	65	100	3
2	PE	PEET802-T	Professional Elective-2	3	--	--	20	15	15	15	65	100	3
3	INT	INTET8030L	Internship	--	--	20	150	--	--	--	150	300	10
Total				**6**	**--**	**20**	**190**	**--**	**--**	**30**	**280**	**500**	**16**

PE: Program Elective, **PJ:** Project, **TA:** Teachers Assessment, **TT1:** Term Test-1, **TT2:** Term Test-2

1. * Professional Elective Courses offered for the students doing Internship at institute level.
2. # Professional Elective Courses offered for the students doing Internship at Industry. These courses are to be studied in self-study mode using NPTEL/Swayam platform.
3. Students doing internship at industry shall submit certificate of NPTEL examination OR they have to appear examinations conducted by institute like TT1, TT2 and ESE.
4. List of NPTEL courses will be declared by concerned BOS at the beginning of semester.

E & TC Department R.C.P.I.T. OFFICE SEAL SHIRPUR

Prepared By
Bhushan V. Patil

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Semester-VII - Professional Elective		
Sr. No.	**Course Code**	**Course Title**
1	PEET7031	Radar Engineering
2	PEET7032	Big Data Analytics
3	PEET7033	Embedded Systems
4	PEET7034	Fundamentals of Speech and Audio Processing
5	PEET7035	Computer Vision
6	PEET7036	SAS

Semester-VII- Open Electives		
Sr. No.	**Course Code**	**Course Title**
1	OEET7041	Product Lifecycle Management
2	OEET7042	Big Management Information System
3	OEET7043	Operations Research
4	OEET7044	Cyber Security and Laws
5	OEET7045	Personal Finance Management
6	OEET7046	Energy Audit and Management
7	OEET7047	Disaster Management and Mitigation Measures
8	OEET7048	Science of Well-being
9	OEET7049	Research Methodology
10	OEET70410	Public Systems and Policies

Semester-VIII - Professional Elective-1		
Sr. No.	**Course Code**	**Course Title**
1	PEET8011	Wireless Network *
2	PEET8012	Satellite Communication*
3	PEET8013	Advanced Digital Signal Processing*
4	PEET8014	Microwave Integrated Circuits *
5	PEET8015	NPTEL/Swayam Course #

Semester-VIII - Professional Elective-2		
Sr. No.	**Course Code**	**Course Title**
1	PEET8021	Optical Communication*
2	PEET8022	5G Technology*
3	PEET8023	Internet Engineering & Network Security*
4	PEET8024	Machine Learning for Signal Processing*
5	PEET8025	NPTEL/Swayam Course #

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Mobile Communication System (PCET7010T)	
Mobile Communication System Laboratory (PCET7010L)	

Pre-requisite:

- Analog & Digital Communication
- Signals and Systems
- Computer Networks

Course Objectives:

- To understand the cellular fundamentals and different types of radio propagation models.
- To study the system architecture of 2G, 2.5 G and 3G.
- To develop the concepts of emerging technologies for 4 G standards and beyond.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify different types of propagation models.	L2	Understand
CO2	Explain the cellular fundamentals and estimate the coverage and capacity of cellular systems.	L3	Apply
CO3	Illustrate the fundamentals and system architecture of GSM, 2.5G, IS-95 and UMTS.	L2	Understand
CO4	Elaborate on the concepts and principles 4G network deployment and optimization.	L3	Apply
CO5	Identify the emerging technologies for upcoming mobile communication systems.	L4	Analyze

Mobile Communication System (PCET7010T)

COURSE CONTENTS

Unit-I Mobile Radio Propagation 5 Hrs.

Large scale fading: Free space propagation model, the three basic propagation mechanisms, reflection, ground reflection (two-ray) model, small scale fading: small scale multipath propagation, types of small-scale fading, Rayleigh and Ricean distributions.

Unit-II Fundamentals of Mobile Communication 10 Hrs.

Introduction to wire1ess communication: The Cellular Concept System Design Fundamentals: Frequency Reuse, Handoff, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems. Features of all conventional multiple access techniques: Frequency division multiple access (FDMA), Time division multiple access (TDMA), Space spectrum multiple access (SSMA), space division multiple access (SDMA), SCFDMA, OFDM, GFDMA.

Unit-III Digital Telephony System (2G and 3G Systems) 8 Hrs.

GSM: GSM Network architecture, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures. GSM evolution: GPRS and EDGE- architecture, radio specifications.

IS-95: Architecture of CDMA system, CDMA air interface, power control in CDMA system, rake receiver. UMTS: Objectives, evolution path to 3G, network architecture, W-CDMA air interface, attributes of W-CDMA system, Cdma2000 cellular technologies: Forward and Reverse Channels.

Unit-IV Advanced Techniques for 4G Deployment 7 Hrs.

LTE Architecture, Physical layer: Frames, slots, and symbols, modulation, coding, Multi-antenna Techniques: Smart antennas, multiple input multiple output systems Cognitive radio: Architecture, spectrum sensing. Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals SDR: Architecture, limitations, advantages, disadvantages.

Unit-V 4G Network Planning and Optimization 8 Hrs.

Network Elements in a LTE Radio Network, User Equipment (UE), Base Station (eNodeB), Key Phenomena in LTE, Interference in LTE, Scheduling, Quality of Service. Radio Network Planning Process, Pre-Planning Phase, Detailed Network Planning LTE Radio Network Optimisation. Initial Tuning, Cluster Tuning, Market Level/Network Tuning, Self-organizing, Networks, Key Performance Indicators, LTE Advanced, Carrier Aggregation, MIMO Coordinated Multi-point Transmission and Reception (CoMP), Relay Nodes.

Unit-VI **Road map towards 5G** **4 Hrs.**

Introduction 5G enabling technologies, Introduction to Femtocell, Femtocell Attributes, Femtocell Standards, Concept of Femtocells, Types of Femtocells Applications of Femtocells.

Mobile Communication System Laboratory (PCET7010L)

List of Laboratory Experiments: (Any Eight)

1. Study of frequency reuse using Matlab/Scilab.
2. To study performance evaluation of handover for absolute signal strength measurement.
3. Tutorial based on fundamentals of frequency reuse and capacity of cellular communication sys- tem.
4. Implementation of adaptive modulation for wireless environment.
5. Study of Rayleigh and Ricean fading distribution using Simulink and computation of link budget using Okumura model.
6. Tutorial based on emerging technologies of 4G.
7. Tutorial based on 3GPP LTE.
8. Scilab Based GSM, CDMA Implementations.
9. Verify use of Orthogonal Walsh codes in CDMA environment.
10. Tutorial based on Propagation Models.

Text Books

1. Theodore S. Rappaport, Wireless communications - principles and practice, 2nd Edn, Pearson.
2. T L Singal, Wireless communications, 2010, Mc Graw Hill Education.
3. Andreas F. Molisch, Wireless communications, 2nd Edn, Wiley India Pvt. Ltd.

Reference Books

1. Upena Dalal, Wireless and Mobile Communications, 2009, Oxford University Press.
2. Vijay K.Garg, Wireless Communications and Networking, 2007, Morgan–Kaufmann series in Networking-Elsevier.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Microwave Engineering (PCET7020T)	
Microwave Engineering Laboratory (PCET7020L)	

Pre-requisite:

- Electromagnetic wave and Propagation
- Electrical Network Analysis and Synthesis

Course Objectives:

- To understand basics of Microwave Communication Systems.
- To understand various Microwave Devices and Measuring Techniques.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze propagation through guiding media using Wave equation and design various Impedance Matching Techniques.	L4	Analyze
CO2	Analyze functioning of different Microwave components.	L4	Analyze
CO3	Analyze Microwave Tubes and derive expressions of necessary performance parameters for them.	L4	Analyze
CO4	Implement communication systems using microwave communication bench set-up and software tool.	L3	Apply
CO5	Measure various circuit parameters at microwave frequency and carry out experimental verification for the same.	L3	Apply

Microwave Engineering (PCET7020T)

COURSE CONTENTS

Unit-I **Basics of Microwave Communication Systems** **2 Hrs.**

Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves. Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnections of Two port networks. High Frequency parameters, Formulation of S- parameters, Properties of S- parameters.

Unit-II **Waveguides and Impedance matching Network and Passive Devices** **10 Hrs.**

Rectangular waveguides: Construction, Working and Mode analysis and Applications. Circular and Ridge Waveguide: Construction and Applications. Design of Impedance matching network using distributed parameters.

Unit-III **Passive and Semiconductor Microwave Devices** **12 Hrs.**

Tees, Hybrid ring, Directional couplers, Phase shifters, Terminations, Attenuators and Ferrite devices such as Isolators, Gyrators, and Circulators. Diodes: Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT. Transistors: BJT, Hetro junction BJT, MESFET and HEMT (construction, working, equivalent circuit and performance characteristics).

Unit-IV **Microwave Generation and Amplification** **10 Hrs.**

Two Cavity Klystron, Multi-Cavity Klystron and Reflex Klystron. Helix Travelling Wave Tube and Cross Field Amplifier. Backward Wave Oscillator, Cylindrical Magnetron and Gyrotron.

Unit-V **Microwave Measurements** **4 Hrs.**

VSWR, Frequency, Power, Impedance, Attenuation, Dielectric Constant.

Unit-VI **Microwave Application and Modern Trends in Microwave Engineering** **4 Hrs.**

Effects of Microwave radiation on human body, Microwave hazards. Medical (Microwave Imagining, Microwave Diathermy) and Civil applications (Microwave heating, Instrumentation landing Systems, Radar Navigation Systems) of microwaves.

Microwave Engineering Laboratory (PCET7020L)

List of Laboratory Experiments: (Any Eight)

1. Study of Microwave Components.
2. Measurement of Microwave frequency using Microwave Bench Setup.
3. Measurement of Attenuation using Microwave Bench Set-up.
4. Study of Various Modes of Reflex Klystron.
5. Compare Analytical and Graphical Method of Impedance Matching for Single Stub.
6. Study of Microwave Hazards.
7. Measurement of Wavelength, VSWR and Unknown load using Microwave Bench Set-up.
8. Measurement of S-parameters for various microwave components.
9. Design and Simulation of Branch line coupler.

Text Books

1. Samuel Liao, Microwave Devices and Circuits, 3rd Edn, Prentice Hall.
2. M. Kulkarni, Microwave and Radar Engineering, 3rd Edn, Umesh Publication.

Reference Books

1. D. M. Pozar, Microwave Engineering, 4th Edn, Wiley Publications. Education.
2. Annapurna Das, Sisir K. Das, Microwave engineering, 3rd Edn, Tata McGraw Hill Publication.
3. Peter A. Rizzi, Microwave Engineering: Passive Circuits, 1st Edn, Prentice Hall.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Radar Engineering (PEET7031T)	
Radar Engineering Laboratory (PEET7031L)	

Pre-requisite:

- Electromagnetic Field Theory
- Analog & Digital Communication
- Antenna and Wave Propagation

Course Objectives:

- To interpret Radar range equations.
- To explain different types of Radar.
- To design Radar transmitters and receivers for given conditions.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the concept of Radar and its applications.	L2	Understand
CO2	Analyze Radar range equation for various condition.	L4	Analyze
CO3	Identify different types of Radar for specific application.	L3	Apply
CO4	Evaluate the design constraints for transmitter and receiver.	L5	Evaluate
CO5	Gain ability to work in teams to solve complex problems and communicate effectively with technical reports / writeups.	L3	Apply

Radar Engineering (PEET7031T)

COURSE CONTENTS

Unit-I **Introduction to Radar** **8 Hrs.**

Basic Radar, Radar range equation. Block Diagram, Radar Frequencies. Applications of Radar.

Unit-II **Radar Equation** **8 Hrs.**

Detection of signal in noise. Receiver Noise and Signal-to-noise Ratio. Probability of detection and false alarm: Simple, complex Targets. Pulse Repetition Frequency.

Unit-III **MTI and Pulse Doppler Radar** **10 Hrs.**

Introduction to Doppler and MTI radar, Doppler frequency shift. Simple CW Doppler radar, MTI radar block diagram. Delay line canceler. Moving-target-detection. Pulse Doppler radar.

Unit-IV **Tracking Radar** **8 Hrs.**

Mono pulse tracking. Conical scan and sequential lobbing. Limitation of tracking accuracy. Low angle tracking.

Unit-V **Radar Transmitter and Receiver** **8 Hrs.**

Radar RF power sources: Klystron, Travelling wave tube, Magnetron. Low power transmitter, high power transmitter. Advantages of solid-state RF power source. Duplexer and Mixer and their types. Receiver noise figure, Super heterodyne Receiver. Radar Display: Types of displays.

Radar Engineering Laboratory (PEET7031L)

List of Laboratory Experiments: (Any Eight)

1. To study basic Radar and range equation.
2. To Study CW Radar and find the relative speed of the object.
3. Derive Radar range equation with noise figure and find the distance.
4. To study MTI Radar and find the blind speed.
5. Calculate pulse repetition frequency and velocity of the moving object.
6. To study various displays used in Radar systems.
7. To study clutters and its effects on Radar range equation.
8. To study delay line canceller.
9. Find the speed of the fan using Doppler Radar.
10. To study duplexer and mixer.
11. To study tracking Radar.

Text Books

1. Merrill Skolnik, Introduction to Radar Systems, 2nd Edn, Tata McGra Hill.
2. G S N Raju, Radar Engineering, 1st Edn, Wiley Publication.
3. Bassem R. Mahafza, Radar Signal Analysis, 1st Edn, CRC press.

Reference Books

1. E. David Jansing, Introduction to Synthetic Aperture Radar, 2nd Edn, Tata Mc-Gra Hill.
2. William L Melvin, James A Scheer, Principles of Modern Radar, 2nd Edn, Institution of Engineering and Technology.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Big Data Analytics (PEET7032T)	
Big Data Analytics Laboratory (PEET7032L)	

Course Objectives:

- To Provide an Overview of an exciting growing field of Big Data Analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSQL, Map Reduce, Spark.
- To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the key issues in big data management and its associated applications for business decisions and strategy.	L2	Understand
CO2	Understand and Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop and NoSQL in big data analytics.	L3	Apply
CO3	Evaluate Big Data processing by using Map Reduce.	L5	Evaluate
CO4	Interpret business models and scientific computing paradigms and apply software tools for big data analytics.	L3	Apply
CO5	Exploring the capabilities of big data using Apache Spark.	L4	Analyze

Big Data Analytics (PEET7032T)

COURSE CONTENTS

Unit-I **Introduction to Big Data Analytics Hadoop** **6 Hrs.**

Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data business approach. Technologies available for Big Data, Infrastructure for Big Data, Big Data challenges. Case Study of Big Data solutions. Introduction to Hadoop, Core Hadoop components, Hadoop Ecosystem, Physical architecture, Hadoop limitations.

Unit-II **NoSQL** **8 Hrs.**

Introduction to NoSQL, NoSQL business drivers, NoSQL case studies. NoSQL data architecture pat- terns: Key-value stores, Graph stores, Column family (Big table) stores, Document stores, Variations of NoSQL architectural patterns, analysing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer Introduction to MongoDB, MongoDB commands.

Unit-III **MapReduce** **8 Hrs.**

MapReduce and The New Software Stack: Distributed File Systems, Physical organization of compute Nodes, Large scale file-system organization. MapReduce: The Map tasks, grouping by key, The Reduce tasks, Combiners, Details of MapReduce execution, Coping with node failures. Matrix vector multiplication using MapReduce, Case studies on MapReduce using Java/Python.

Unit-IV **Techniques in Big Data Analytics** **12 Hrs.**

Finding Similar Item: Nearest Neighbour Search, Similarity of Documents. Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis. Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine.

Frequent Item set Mining: Market Basket Model- Applications, Association Rule- Confidence, Interest, Support, Apriori Algorithm - Pass1, Pass2, Recommendation Systems: Introduction, Collaborative-Filtering System, Content based recommendation system.

Unit-V **Big Data Analytics using Apache Spark** **8 Hrs.**

Introduction to Spark: Features, Spark built on Hadoop, Components of Spark Resilient Distributed Datasets: Data sharing using Spark RDD, Iterative operations on Spark RDD, Interactive operations on Spark RDD, Spark installation, Core programming, RDD transformations, Execution of word count transformation.

Big Data Analytics Laboratory (PEET7032L)

List of Laboratory Experiments: (Any Eight)

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Start-up scripts, Configuration files.
2. Hadoop Implementation of file management tasks.
3. Installation of MongoDB, and execution of CREATE, INSERT, DELETE and UPDATE operations.
4. Querying in MongoDB using FIND command, aggregate functions etc.
5. Execution of PIG SCRIPTING language.
6. Execution of HIVE SCRIPTING language.
7. Execution of Matrix Multiplication Using MapReduce.
8. Execution of Word Count using MapReduce.
9. Execution of Word Count using Apache Spark.
10. Case Study on Recommendation Systems.

Text Books

1. Radha Shankarmani and M Vijayalakshmi, Big Data Analytics, 2nd Edn, Wiley Publication.
2. Alex Holmes, Hadoop in Practice, 2012, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly, Making Sense of NoSQL – A guide for managers and the rest of us, 2013, Manning Press.
4. Andy Konwinski, Matei Zaharia, Holden Karau, Learning Spark, 2015, O'Reilly Media, Inc.

Reference Books

1. Bill Franks, Taming, The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics, 2012, Wiley Publication.
2. Chuck Lam, Hadoop in Action, 2010, Dreamtech Press.
3. Bill Chambers, Matei Zaharia, Spark: The Definitive Guide, 2018, O'Reilly Media, Inc.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Embedded Systems (PEET7033T)	
Embedded Systems Laboratory (PEET7033L)	

Pre-requisite:

- Microprocessors & Microcontrollers
- Digital Electronics

Course Objectives:

- To develop background knowledge of Embedded Systems.
- To understand Embedded Systems communication techniques.
- To write programs for Embedded Systems and Real Time Operating Systems.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the Embedded System characteristics, design metrics and development life cycle.	L2	Explain
CO2	Discuss different processor design techniques and architectures with example.	L3	Apply
CO3	Identify different communication types and buses with different protocols.	L2	Classify
CO4	Describe concepts and components of Real Time Operating system.	L2	Explain
CO5	Gain ability to work in teams to solve complex problems and communicate effectively with technical reports / write ups.	L3	Apply

Embedded Systems (PEET7033T)

COURSE CONTENTS

Unit-I **Embedded System Overview** **6 Hrs.**

Definition of Embedded System, Embedded Systems vs General Computing Systems, Classification, Major Application Areas, Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle.

Unit-II **Processor** **8 Hrs.**

Overview of Custom Single-Purpose Processors, General-Purpose Processors, Standard Single-Purpose Processors, RISC and CISC architectures, GCD example.

Unit-III **Communication** **6 Hrs.**

CAN bus, I2C, MOD bus, SPI, Examples on Parallel Communication, Serial Communication, Wire- less Communication.

Unit-IV **Real Time Operating Systems (RTOS)** **6 Hrs.**

Operating system basics, Types of OS, Tasks, process, Threads, Multiprocessing and, Multitasking, Task scheduling, Threads, Process, Scheduling.

Unit-V **Real Time Operating Systems (RTOS)** **8 Hrs.**

Task communications, Task synchronization, Device drivers, How to choose RTOS, Examples of RTOS.

Unit-VI **Design examples and case studies of program model and programming with RTOS** **8 Hrs.**

Digital Camera, Introduction to simple digital camera, Requirements and specifications, Design using Microcontroller and Microcontroller and CCDPP, Automatic Chocolate Vending Machine, Adaptive Cruise Control in car.

Embedded Systems Laboratory (PEET7033L)

List of Laboratory Experiments: (Any Eight)

1. Interfacing of I2C, CAN, SPI, ZigBee etc. with ARM.
2. Speed Control of DC Motor using ARM.
3. Simulation of multitasking using RTOS.
4. Simulation of mutex using RTOS.
5. Simulation of mailboxes using RTOS.
6. Inter process communication using semaphore in RTOS.
7. Simulation of message queues using RTOS.
8. Simulate the scheduling algorithms.
9. Mini Project.

Text Books

1. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software In- troduction, 3rd Edn, Wiley Publication.
2. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd Edn, Tata McGraw- Hill Publication.
3. Sriram Iyer and Pankaj Gupta, Embedded Real-time Systems Programming, 1st Edn, Tata McGraw-Hill Publication.

Reference Books

1. David Simon, An Embedded Software Primer, 1st Edn, Pearson Publication.
2. K.V. Shibu, Introduction to Embedded Systems, 2nd Edn, McGraw Hill.
3. K.V.K. Prasad, Embedded Systems / Real-Time Systems: Concepts, Design Programming, 1st Edn, Dreamtech Press.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Fundamentals of Speech and Audio Processing (PEET7034T)	
Fundamentals of Speech and Audio Processing Laboratory (PEET7034L)	

Pre-requisite:

- Signals and Systems
- Digital Signal Processing
- Engineering Mathematics

Course Objectives:

- To understand basic concepts and methodologies for the analysis and modelling of speech signal.
- To characterize the speech signal as generated by a speech production model.
- To understand the mechanism of speech and audio perception.
- To understand the digital representation of the speech waveform.
- To perform the analysis of speech signal using STFT.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate advanced Knowledge in Digital model representation of speech signal.	L3	Apply
CO2	Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.	L6	Create
CO3	Analyse speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).	L4	Analyze
CO4	Formulate and design a system for speech recognition and speaker recognition.	L6	Create
CO5	Acquired knowledge about audio and speech signal estimation and detection.	L2	Understand

Fundamentals of Speech and Audio Processing (PEET7034T)

COURSE CONTENTS

Unit-I **Digital Representations of the Audio Waveform** **5 Hrs.**

Sampling audio signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation.

Unit-II **Digital Models for Speech signals** **5 Hrs.**

Speech Production, Acoustic Phonetics and Auditory Perception, Anatomy and physiology of speech organs, articulatory phonetics, acoustic phonetics, acoustic theory of speech production, discrete time model for speech production. Ear physiology

Unit-III **Time dependent processing of speech signals** **8 Hrs.**

Short time energy and average magnitude, short time average zero crossing rate, Speech V/S silence discrimination using energy Zero crossings, Pitch period estimation, short time autocorrelation function, short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing. Pitch period estimation based on FFT and harmonic peak detection method, estimation of formants using log spectrum.

Unit-IV **Short time Fourier Transform** **8 Hrs.**

Introduction- Definition and Properties, Fourier Transform Interpretation, Linear Filtering Interpretation, Sampling rates of Xn (e^{jw}) in Time and Frequency, Filter Bank Summation Method of Short-Time Synthesis, Overlap Addition Method for Short -Time Synthesis.

Unit-V **Homomorphic Processing** **8 Hrs.**

Cepstral analysis of speech, mel frequency cepstral coefficients (MFCC), perceptual linear prediction (PLP), Pitch period estimation in cepstral domain, evaluation of formants using cepstrum.

Unit-VI **LPC and Parametric Speech Coding** **8 Hrs.**

Review of lattice structure realization, forward and backward error filters, normal equations its solutions, levinson-durbin algorithm, Berg's algorithm. Vocoder- Voice excited channel vocoder, Voice excited and error signal excited LPC vocoders, code excited LP (CELP) based vocoders, Adaptive predictive coding of speech, Auditory Modelling. Audio quality analysis: Objective analysis methods- PEAQ, Subjective analysis methods - MOS score. Speech Recognition using Dynamic Time Warping and Hidden Markov Models.

Fundamentals of Speech and Audio Processing Laboratory (PEET7034L)

List of Laboratory Experiments: (Any Eight)

1. To record the name of student in Praat and plot its spectrogram.
2. Plot a vowel file ‘a’ and its Welch power spectral density estimate.
3. To calculate positive and negative ZCR for a voiced and unvoiced speech segment.
4. A program to find pitch period using method of autocorrelation.
5. A MATLAB program to find pitch frequency using spectrum method for unvoiced segment.
6. Program for finding cepstrum of speech segment.
7. To find formants using power spectrum estimate using Welch method and method of period grams for voiced segment of speech.
8. A program to use Homomorphic processing and extract the impulse response of the vocal tract.
9. Program to convert frequency to Mel scale.
10. To find LPC and reflection coefficients using Levinson Durbin algorithm.

Text Books

1. Rabiner and Schafer, Digital Processing of Speech Signals, Pearson Education, 2004
2. Shaila D. Apte, Speech and Audio Processing, Wiley India, 2012.
3. Douglas O’Shaughnessy, Speech Communications: Human Machine□, 2nd Edn, Universities Press.
4. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, 2001, Prentice Hall.
5. J. L. Flanagan, Speech Analysis Synthesis and Perception, 2nd Edn, Springer Verlag.

Reference Books

1. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, Wiley India (P) Ltd, 2006.
2. L. R. Rabiner, B. H. Juang, B. Yegnanarayana, Fundamentals of speech Recognition, Pearson Education, 1993.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Computer Vision (PEET7035T)	
Computer Vision Laboratory (PEET7035L)	

Pre-requisite:

- Digital Signal Processing
- Engineering Mathematics

Course Objectives:

- Exemplify fundamental concepts related to multidimensional signal processing, feature extraction, pattern analysis and clustering.
- Obtain and process image data and relate it to 3D scene structures.
- Familiarize with the necessary tools of Computer Vision such as OpenCV, Matlab, and Python etc.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply computer vision algorithms to edge detection, motion and object recognition.	L2	Apply
CO2	Recognize geometrical relationships between 2D and 3D world.	L3	Apply
CO3	Design and develop practical and innovative Image Processing and Computer Vision applications or systems.	L6	Create

Computer Vision (PEET7035T)

COURSE CONTENTS

Unit-I **Segmentation –I** **8 Hrs.**

Edge Detection: - Canny, a model fitting method for edge detection – RANSAC LOG, DOG. Lines- Hough Transform, Image Pyramids and Gaussian derivative filters.

Unit-II **Segmentation –II** **8 Hrs.**

Key Point Localization, Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH

Unit-III **Precursor** **10 Hrs.**

Transformation Matrices – Homogeneous coordinates – Translation, Rotation Camera Models: Intrinsic and Extrinsic Camera Parameters, Homogeneous Coordinates, Perspective Projection Transformation,3- D Rotation of Points, Camera Calibration, Properties of Projection, Orthographic and Weak Perspective Projection.

Unit-IV **Optical Flow** **8 Hrs.**

Computations for motion estimation and depth calculation, Horn and Schunk, Lucas and Kanade algorithms, Motion Segmentation. Convolution Neural Networks: Design and Implementation.

Unit-V **Clustering Solutions for Segmentation** **8 Hrs.**

Agglomerative Hierarchical Clustering – Algorithm, K-means Clustering, PCA and Eigen faces, Linear Discriminant Analysis and Fisher faces.

Computer Vision Laboratory (PEET7035L)

List of Laboratory Experiments: (Any Eight)

1. Implementation of Viola Jones Algorithm for face recognition.
2. Segmentation of Images using Canny Edge Detector.
3. Segmentation of Image using k-means algorithm.
4. Optical Flow with Lucas-Kanade method.
5. Image Compression using Principal Component Analysis.
6. Corner Detection using the Harris Corner Detector.
7. Implementation of ALEXNET or RESNET architectures for any desired application.
8. Segmentation based on Image Texture.
9. Tensor Flow: Introduction (any one application).
10. Transformer: Introduction (any one application).

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education 2003.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley 1992.

Reference Books

1. O. Marques, Practical Image and Video Processing using Matlab, IEEE Press, Wiley, 2011.
2. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Edn, Academic Press, Morgan Kaufmann.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Statistical Analysis System (PEET7036T)	
Statistical Analysis System Laboratory (PEET7036L)	

Pre-requisite:

- Probability & Statistics
- Engineering Mathematics
- Data Structures

Course Objectives:

- Business Analytics refers to skills, practices and techniques used in converting data into information and knowledge that aid business decision making.
- Statistical learning including quantitative, qualitative analysis techniques
- The use of the above analysis and visualization to aid decision making.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Able to familiar with Base SAS programming.	L2	Understand
CO2	Demonstrate visual analytics.	L3	Apply
CO3	Design the report using reporter.	L6	Create
CO4	View various reports using different media devices.	L2	Understand

Statistical Analysis System (PEET7036T)

COURSE CONTENTS

Unit-I **Introduction to Base SAS** **8 Hrs.**

SAS Program: Introduction to SAS program, submitting a SAS program – SAS Studio, SAS Enterprise Guide, SAS Windowing environment, SAS program syntax Accessing Data: Examining SAS Data sets, Accessing SAS Libraries Producing Detail Reports: Subsetting Report data, Sorting and Grouping Report data, Enhancing Reports Formatting Data Values: Using SAS Formats, User de- fined Formats

Unit-II **Reading SAS Dataset, Spreadsheet and Database data** **4 Hrs.**

Reading SAS Dataset. Customize SAS Dataset. Router Reading Spreadsheet Data Reading database data.

Unit-III **Visual Analytics** **6 Hrs.**

Getting Stated with SAS Visual Analytics: Exploring SAS VA concepts, Using Home Page Administrating the Environment and Managing Data: Exploring Data Builder, Exploring Administrator. Demonstrations and Exercises.

Unit-IV **Using the Explorer** **8 Hrs.**

Selecting Data and defining Data Item properties Creating Visualisations, Enhancing Visualisations with Analytics Interacting with Visualizations and Explorations

Unit-V **Designing Reports with Reporter** **8 Hrs.**

Creating a Simple Report Creating Data Items and Working with Graphs Working with Filters and Report sections Working with other objects Demonstrations and Exercises

Unit-VI **Viewing SAS VA Reports and Case Study** **8 Hrs.**

Creating Analyses and Reports. Viewing Reports on the Web Viewing Reports on the Mobile Device/ Office Analytics Case Study – Creating Analyses and Reports

Statistical Analysis System Laboratory (PEET7036L)

List of Laboratory Experiments: (Any Eight)

1. Importing data in SAS from Excel and CSV file.
2. Creating summary statistical data.
3. Exporting results to Excel and PDF.
4. Manipulating data with functions.
5. Using data with formats like charts and graphs.
6. Creating data by applying filters and performing data analysis on it.
7. Working with graph level display rules.
8. Analyzing a Text data source.

Text Books

1. SAS programming 1 – Essentials.
2. SAS Visual Analytics – Fast Track.
3. SAS Support

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Product Life Cycle Management (OEEE7041T)	

Prerequisite:

- Knowledge of basic concepts of Management.

Course Objectives

- To familiarize the students with the need, benefits and components of PLM.
- To acquaint students with Product Data Management and PLM strategies.
- To give insights into new product development program and guidelines for designing and developing a product.
- To familiarize the students with Virtual Product Development.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Illustrate various approaches and techniques for designing and developing products.	L3	Apply
CO3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3	Apply
CO4	Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L3	Apply

Product Life Cycle Management (OEEE7041T)

COURSE CONTENTS

Unit-I Introduction to Product Lifecycle Management (PLM) 9 Hrs.

Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance and Benefits of PLM, Widespread Impact of PLM, Focus and Application.

A PLM Project, Starting the PLM Initiative, PLM Applications. PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM.

Unit-II Product Design 9 Hrs.

Product Design and Development Process, Engineering Design, Organization and De-composition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process

Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process.

Unit-III Product Data Management (PDM) 9 Hrs.

Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies.

Unit-IV Integration of Environmental Aspects in Product Design 8 Hrs.

Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.

Unit-V Life Cycle Assessment and Life Cycle Cost Analysis 7 Hrs.

Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards,

Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis.

Text Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004, ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor and Francis, 2006.

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, 2009, ISBN: 3540257314.
2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265.
3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", Wiley, 2010.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Management Information System (OEEE7042T)	

Prerequisite:

- Knowledge of basic concepts of Management.

Course Objectives

- The course is blend of Management and Technical field.
- To discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
- To define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
- To identify the basic steps in systems development.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain how information systems Transform Business.	L2	Understand
CO2	Use information systems concepts to assess their effects on organizational operations.	L3	Apply
CO3	Describe IT infrastructure and its components and its current trends.	L2	Understand
CO4	Explain principal tools and technologies for accessing in-formation from databases to improve business performance and decision making.	L2	Understand
CO5	Use enterprise-wide knowledge management systems to show their benefits for business operations.	L3	Apply

Management Information System (OEEE7042T)

COURSE CONTENTS

Unit-I **Foundation Concepts** **3 Hrs.**

Information Systems in Business, Functional Area Information System, The Components of Information Systems, Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.

Unit-II **Information Technologies:** **7 Hrs.**

Hardware and Software, Computer Systems: End User and Enterprise Computing Computer Peripherals: Input, Output, and Storage Technologies Application Software: End User Applications, System Software: Technical Foundations of Database Management, Managing Data Re-sources, Big data, Data warehouse and Data Marts, Knowledge Management.

Unit-III **MIS Tools and applications for Decision making** **8 Hrs.**

ERP and ERP support of Business Process Reengineering. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Visualization. Artificial Intelligence Technologies in Business

Unit-IV **Security and Ethical Challenges** **8 Hrs.**

Security and Ethical Challenges: Security, Ethical, and Societal Challenges of IT Security Management of Information Technology.

Unit-V **Social Computing (SC)** **8 Hrs.**

Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.

Unit-VI **Information System within Organization** **8 Hrs.**

Information System within Organization: Acquiring Information Systems and Applications: Various System development life cycle models. Enterprise and Global Management of Information Technology: Managing Information Technology, Managing Global IT.

Reference Books:

1. James A O'Brien, George M., Ramesh Behl, "Management Information Systems", 11th Edition, Tata McGraw Hill, 2019.
2. Kelly Rainer, Brad Prince, "Management Information Systems", 2nd Edition, Wiley, 2013.
3. K.C. Laudon and J.P. Laudon, "Management Information Systems: Managing the Digital Firm", 10th Edition, Prentice Hall, 2007.
4. D. Boddy, A. Boonstra, "Managing Information Systems: Strategy and Organization", Prentice Hall, 2008.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Operations Research (OEET7043T)	

Prerequisite:

- Basic Knowledge of Algebra, Probability and Statistics

Course Objectives

- To formulate a real-world decision problem as a mathematical programming model.
- To learn the mathematical tools that are employed to solve mathematical programming models.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a real-world problem by formulating it as a Linear Programming Problem and interpreting the solution obtained using the Simplex method or other	L4	Analyze
CO2	Determine real-world problems as Transportation Problem and Assignment Problem and solve the decision problem by choosing appropriate algorithm.	L3	Apply
CO3	Determine the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.	L3	Apply
CO4	Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.	L2	Understand
CO5	Explain the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.	L2	Understand
CO6	Explain the concept of simulation and replacement policy, apply Monte Carlo Simulation technique to systems such as inventory and queuing, and determine optimal replacement age.	L2	Understand

Operations Research (OEEE7043T)

COURSE CONTENTS

Unit-I **10 Hrs.**

Introduction to Operations Research: Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization. Linear Programming Problem: Mathematical Formulation.

Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.

Unit-II **8 Hrs.**

Assignment Problems: Mathematical Formulation, finding optimal solution - Hungarian Method Transportation problem: Mathematical Formulation, finding initial basic feasible solution- Northwest corner rule, row minima, column minima, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Improving the solution.

Unit-III **6 Hrs.**

Dynamic Programming: Bellman's Principle of optimality - Applications of dynamic Programming-Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem.

Unit-IV **10 Hrs.**

Queuing Models: Characteristics of queuing models. Single Channel – Single and multiphase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity. Multichannel- Single phase server - Poisson arrivals, exponential service time with infinite population.

Game Theory: Introduction, Minimax and Maximin Criterion and optimal strategy, Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle.

Approximate methods, Iterative method, m x 2 and 2 x n Games-Graphical method and method of sub-games. Expressing game as LPP.

Unit-V **8 Hrs.**

Simulation: Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages. Replacement Models: Replacement of items that deteriorate with time - when money value is not counted and counted, Replacement of items that fail suddenly – individual and group replacement policy.

Text Books:

1. Sharma J. K., “Operations Research”, Trinity Press.
2. Gupta P. K., Hira D. S., “Operations Research”, S. Chand Limited.

Reference Books:

1. Taha, H. A., “Operations Research - An Introduction”, Pearson Education, 2022.
2. Ravindran A., Phillips D. T., and Solberg J. J., “Operations Research: Principles and Practice”, John Willey and Sons, 2009.
3. Hiller F. S., and Liebermann G. J., “Introduction to Operations Research”, Tata McGraw Hill, 2010.
4. Pradeep Prabhakar Pai, “Operations Research Principles and Practice”, Oxford University Press, 2012.
5. R. Panneerselvam, “Operations Research”, PHI Publications, 2nd Edition, 2016.
6. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, “Operations Research”, Pearson Education, 2nd Edition, 2014.
7. Kanti Swarup, P. K. Gupta and Man Mohan, “Operations Research”, Sultan Chand and Sons, 2010.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Cyber Security and Laws (OEEE7044T)	

Prerequisite:

- Knowledge of basic concepts of security.

Course Objectives

- To understand and identify different types cybercrime and cyber offences.
- To recognized Indian IT Act 2008 and its latest amendments.
- To learn various types of security standards compliances.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the different types of cybercrime and security issues E Business.	L2	Understand
CO2	Analyze different types of cyber threats and techniques for security management.	L4	Analyze
CO3	Analyze the legal requirements and standards for cyber security in various countries to regulate cyberspace.	L4	Analyze
CO4	Explain the Information Technology Act and the legal framework of right to privacy, data security, and data protection.	L2	Understand

Cyber Security and Laws (OEEE7044T)

COURSE CONTENTS

Unit-I **Introduction to Cybercrime** **10 Hrs.**

Introduction to Cybercrime: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus and Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling.

Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and D DoS attacks, SQL Injection, Buffer Over Flow,, Phishing Identity Theft (ID Theft) ,How criminal plan the attacks, Social Engineering, Cyber stalking.

Unit-II **Cyber Threats Analysis** **7 Hrs.**

Cyber Threats Analysis: Knowledge of Dynamic and Deliberate Targeting, Knowledge of Indications and Warning, Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions, Knowledge of Key Cyber Threat Actors and their Equities Knowledge of Specific Target Identifiers and Their Usage.

Unit-III **Electronic Business and legal issues** **8 Hrs.**

Electronic Business and legal issues: Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic. Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E-Cheque, E-Cash, E-Payment Threats and Protections, Security for E-Commerce.

Unit-IV **Indian IT Act** **8 Hrs.**

Indian IT Act: Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments Security aspect in cyber-Law: The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law.

Unit-V **Security Industries Standard Compliances** **9 Hrs.**

Security Industries Standard Compliances: IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI-DSS. OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Centre for Internet Security Controls)

Reference Books:

1. Nina Godbole, Sunit Belapure, “Cyber Security”, Wiley India, 2011.
2. Suresh T. Vishwanathan, “The Indian Cyber Law”, 3rd Edition, Bharat Law House, 2022.
3. “The Information Technology Act, 2000”, Bare Act- Professional Book Publishers, New Delhi, 2022.
4. Anup K. Ghosh, “E-Commerce Security and Privacy”, Springer Science and Business Media, 2012.
5. Izzat Alsmadi, “The NICE Cyber Security Framework Cyber Security Intelligence and Analytics”, 1st Edition, Springer, 2019.
6. Advocate Prashant Mali, “Cyber Law and Cyber Crimes”, 2nd Edition, Snow White Publications, 2015.
7. Nina Godbole, “Information Systems Security”, 2nd Edition, Wiley India, 2017.
8. Kennetch J. Knapp, “Cyber Security and Global Information Assurance”, Information Science Publishing, 2009.
9. William Stallings, “Cryptography and Network Security”, 8th Edition, Pearson Publication, 2023.

Web Resources:

1. The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in
2. A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Personal Finance Management (OEEE7045T)	

Prerequisite:

- Basic Knowledge of Algebra, Probability and Statistics.

Course Objectives

- To create awareness and educate consumers on access to financial services.
- To make the students understand the basic concepts, definitions and terms related to direct taxation.
- To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
- To familiarise the students with microfinance for accelerating the expansion of local microbusinesses.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Use a framework for financial planning to understand the overall role finances play in his/her	L3	Apply
CO2	Calculate income from salaries, house property, business/profession, capital gains and income from other sources.	L3	Apply
CO3	Calculate the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.	L3	Apply
CO4	Describe how Microfinance can help in financial inclusion.	L2	Understand

Personal Finance Management (OEEE7045T)

COURSE CONTENTS

Unit-I **Overview of Indian Financial System** **7 Hrs.**

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion.

Introduction to Personal Finance: Person Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II **Personal Financial Management** **8 Hrs.**

Personal Financial Management: Loans: Home, Car, Education, Personal, Loan against property and Jewel loan.

Insurance: Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance. Investment: Investing Basics and Evaluating Bonds, investing in Stocks and Investing in Mutual Funds, Planning for the Future.

Unit-III **Income Tax Act Basics** **9 Hrs.**

Income Tax Act Basics: Introduction to Income Tax Act, 1961.Heads of Income and Computation of Total Income and Tax Liability: Income and Computation of Total Income under various heads, Clubbing Provisions, set off and carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons. Tax Management, Administrative Procedures and ICDS: TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV **Goods and Services Tax** **9 Hrs.**

Goods and Services Tax: GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union and State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST and IGST); GST Council, GST Network, State Compensation Mechanism, Registration.

Levy and Collection of GST: Taxable event - “Supply” of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST - Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services.

Unit-V **Introduction to Microfinance** **9 Hrs.**

Introduction to Microfinance: Micro-Finance: Definitions, Scope and Assumptions, Types of Micro-finance, Customers of Microfinance, Credit Delivery Methodologies, SHG concept, origin, Formation and Operation of Self-Help Groups (SHGs).

Models in Microfinance: Joint Liability Groups (JLG), SHG Bank Linkage Model and

GRAMEEN Model: Achievements and Challenges.

Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs), Constraints and Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand and Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs.

Reference Books:

1. Asha Singh, M.S. Gupta, “Banking and Financial Sector Reforms in India”, Serials Publication, 2010.
2. M. S. Gupta and J. B. Singh, “Indian Banking Sector: Essays and Issues”, 1st Edition, Serials Publication, 2016.
3. K.M. Bhattacharya O.P. Agarwal, “Basics of Banking and Finance”, Himalaya Publishing House, 2018.
4. S. Subba Reddy, P. Raghu Ram, “Agricultural Finance and Management”, Oxford and IBH Publishing, 2018.
5. Dr. Vasant Desai, “The Indian Financial System and Development", 4th Edition, Himalaya Publishing House, 2011.
6. Sanjay Kumar Satapathy, “Income Tax Management Simple Way of Tax Management, Tax Planning and Tax Saving”, 2018.
7. Dr. R. K. Jain, “Direct Tax System Income Tax”, SBPD Publications, 2020.
8. S K Mishra, “Simplified Approach to GST Goods and Services Tax”, Educreation Publishing, 2018.
9. Todd A Watkins, “Introduction to Microfinance”, World Scientific Publishing Company, 2020.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Energy Audit and Management (OEET7046)	

Prerequisite:

- Basic Knowledge of Social science and Current affairs.

Course Objectives

- To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
- To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify and describe the present state of energy security and its importance.	L2	Understand
CO2	Identify and describe the basic principles and methodologies adopted in the energy audit of a utility.	L2	Understand
CO3	Describe the energy performance evaluation of some common electrical installations and identify energy-saving opportunities.	L2	Understand
CO4	Describe the energy performance evaluation of some common thermal installations and identify energy-saving opportunities.	L2	Understand
CO5	Analyze the data collected during performance evaluation and recommend energy-saving measures.	L4	Analyze

Energy Audit and Management (OEET7046)

COURSE CONTENTS

Unit-I **5 Hrs.**

Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.

Unit-II **10 Hrs.**

Energy Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring and targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI) Internal rate of return (IRR).

Unit-III **10 Hrs.**

Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment's and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.

Unit-IV **10 Hrs.**

Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation- types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.

Unit-V **7 Hrs.**

Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.

Reference Books:

1. Geofry Stokes, “Handbook of Electrical Installation Practice”, Blackwell Science, 2003.
2. Anil Valia, “Designing with light: Lighting Handbook”, Lighting System.
3. W. C. Turner, “Energy Management Handbook”, Fairmont Press, 5th Edition, 2004.
4. A. K. Tyagi, “Handbook on Energy Audits and Management”, Tata Energy Research Institute, 2000.
5. C. B. Smith, “Energy Management Principles”, Elsevier Science Publishing, 2nd Edition, 2015.
6. Dale R. Patrick, S. Fardo, Ray E. Richardson, “Energy Conservation Guidebook”, Fairmont Press, 2nd Edition, 2007.
7. Albert Thumann, W. J. Younger, T. Niehus, “Handbook of Energy Audits”, Fairmont Press, 6th Edition, 2010.

Web Resources:

1. www.energymanagertraining.com
2. www.bee-india.nic.in

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Disaster Management and Mitigation Measures (OEET7047)	

Course Objectives

- To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.
- To identify extent and damaging capacity of a disaster.
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand roles and responsibilities of individual and various organization during and after disaster.
- To appreciate the significance of GIS, GPS in the field of disaster management.
- To understand the emergency government response structures before, during and after disaster.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe natural as well as man-made disasters, their extent, and possible effects on the economy.	L2	Understand
CO2	Describe the institutional framework and organizational structure in India for disaster management and explain government policies, acts, and various emergency laws.	L2	Understand
CO3	Describe the simple dos and don’ts during extreme events and explain the skills required to respond accordingly	L2	Understand
CO4	Explain the importance of disaster prevention and various mitigation measures with exposure to disaster hotspots across the globe.	L2	Understand

Disaster Management and Mitigation Measures (OEET7047)

COURSE CONTENTS

Unit-I **9 Hrs.**

General Information about Disaster: Brief concept of Hazards, definition and types of Disasters – Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters, Impact of disaster on National development.

Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc.

Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit-II **8 Hrs.**

Disaster Management: Brief Introduction, Disaster management cycle, Evolution of Disaster and Dis-aster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc. Prior, During and Post disaster management activities: (Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public aware-ness, Research, Reconstruction of essential services and livelihood restoration

Unit-III **8 Hrs.**

Institutional framework and Mechanism for disaster management in India: Institutions in India for dealing with various disasters, Organizational structure, functions and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster.

NGO's involved in disasters and their task, Jobs carried out by armed forces. Financial Relief During disaster (State, National and International Disaster Assistance)

Unit-IV **8 Hrs.**

Disaster risk reduction and Mitigation Measures: Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.

Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc. Use of information

management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.

Unit-V **9 Hrs.**

Case studies on disaster (National /International): Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on.(Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)

Reference Books:

1. H. K. Gupta, "Disaster Management", Universities Press, 2003.
2. O. S. Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", Centre for Land Warfare Studies, 2011.
3. D. Copolla, "Introduction to International Disaster Management", Butterworth-Heinemann, Else-vier, 2015.
4. J. Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis, 2008.
5. R. Dasgupta,"Disaster Management and Rehabilitation", Mittal Publications, 2007.
6. R. B. Singh, "Natural Hazards and Disaster Management, Vulnerability and Mitigation", Rawat Publications, 2006.
7. C. P. Lo and A. K. W. Yonng, "Concepts and Techniques of GIS", Prentice Hall (India), 2006.
8. C. G. F. Gonzales, "Risk Management of Natural Disasters", KIT Scientific Publishing, 2010.
9. W. N. Carter, "Disaster Management – A Disaster Manager's Handbook", Asian Development Bank, 2008.
10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs, Government of India, New Delhi, 2011.
11. W. Mara, "The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy", Marshall Cavendish Corporation, 2011.
12. R. Eisler, "The Fukushima 2011 Disaster", Taylor and Francis, 2013. (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Science of Well-being (OEET7048)	

Course Objectives

- To create consciousness about importance of holistic health and physical as well as mental well-being.
- To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
- To introduce the learners to the means of mental and physical well-being, ill effects of mal- practices like alcoholism, smoking etc.
- To equip the learners to manage and cope up with stress in their daily living.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe concepts of holistic health and well-being, differentiate between its true meaning and	L2	Understand
CO2	Describe the meaning of happiness, practice gratitude and self-compassion, and analyze incidents from one's own life	L4	Analyze
CO3	Explain the causes and effects of stress, identify reasons for stress in one's own surroundings and self.	L2	Understand
CO4	Describe the importance of physical health and fitness, assess one's lifestyle, and justify its limitations or effective-ness.	L5	Evaluate
CO5	Analyze one's own coping mechanisms, assess their effectiveness, develop and strategize for betterment, and execute them.	L4	Analyze

Science of Well-being (OEET7048)

COURSE CONTENTS

Unit-I **Health and Well-being** **9 Hrs.**

The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being. Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.

Unit-II **Concepts of Happiness** **8 Hrs.**

Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Nar-row vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.

Unit-III **Stress and Mental Health / Well-being** **9 Hrs.**

Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress. Sources of stress and how does stress cause illness, various sources of stress, delineate between sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.

Unit-IV **Physical Well-being / Health Management** **8 Hrs.**

Concept of health behaviours, dimensions of health behaviours. Health enhancing behaviours: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviours and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, concept of Malnutrition, Health compromising behaviours: Alcoholism, Smoking and its effects on health.

Unit-V **Dealing with Difficult Times / Coping mechanisms** **8 Hrs.**

The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders. Concept of coping, Ways of coping and stress management, basic knowledge about stress management, various techniques of stress management, stress management programs. Mental strengths and virtues, Hope, Optimism, Resilience - concept, pathways and models, Meditation and Self-introspection.

Text Books:

1. Felicia Huppert, Nick Baylis, Barry Keverne, “The Science of well-being", Oxford University Press, 2005.
2. S. Ojha, U. Rani Srivastava, Shobhna Joshi, “Health and Well-Being: Emerging Trends”, Global Vision Publishing House, 2010.
3. Charles Richard Snyder, Shane, J. Lopez, Jennifer Teramoto Pedrotti, “Positive Psychology: The scientific and Practical Explorations of Human Strengths”, 2nd Edition, Sage Publications, 2011.

Reference Books:

1. Kitayama S. and Markus H. R., “The Pursuit of Happiness and the Realization of Sympathy: Cultural Patterns of Self, Social Relations, and Well-being”, Culture and subjective well-being, The MIT Press, 2000.
2. Dubos R., “Man Adapting New Haven”, Yale University Press, 1980.
3. McMahon D. M., “Happiness a history”, Atlantic Monthly Press, 2006.
4. D. Kahneman, E. Diener and N. Schwarz, “Well-being: The Foundations of Hedonic Psychology”, Russell Sage Foundation, 1999.
5. Selye H., “The Stress of Life”, McGraw-Hill, 1984.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Research Methodology (OEET7049)	

Prerequisite:

- Basic Knowledge of Probability and Statistics.

Course Objectives

- To understand Research and Research Process.
- To acquaint learners with identifying problems for research and develop research strategies.
- To familiarize learners with the techniques of data collection, analysis of data and interpretation.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply preliminary research design concepts for projects in their subject matter areas.	L3	Apply
CO2	Analyze and report research data using appropriate statistical and analytical techniques.	L4	Analyze
CO3	Explain complex data or situations clearly.	L2	Understand
CO4	Analyze the research findings.	L4	Analyze
CO5	Summarize a structured research report based on research findings.	L2	Understand

Research Methodology (OEET7049)

COURSE CONTENTS

Unit-I **7 Hrs.**

Basic Research Concepts: Meaning of research, Objectives of research, Types of research, Significance of research process.

Unit-II **10 Hrs.**

Research Methodology: Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.

Unit-III **10 Hrs.**

Research and Sample Design: Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs.

Unit-IV **10 Hrs.**

Data Collection and Data Analysis: Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data.

Unit-V **5 Hrs.**

Interpretation and Report Writing: Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues.

Reference Books:

1. Dawson, Catherine, "Practical Research Methods", 1st Edition, UBS Publishers Distributors, 2002.
2. Kothari C. R., "Research Methodology- Methods and Techniques", 2nd Edition, Wiley Eastern Limited, 2004.
3. Kumar, Ranjit, "Research Methodology- A Step-by-Step Guide for Beginners", 3rd Edition, Pearson Education, 2010.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Public Systems and Policies (OEET70410)	

Prerequisite:

- Basic Knowledge of Social science and Current affairs.

Course Objectives

- To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
- To understand public systems in a fast-changing environment in the global context.
- To provide an indepth understanding of the ills prevailing in the society and aids to identify the solutions for them.
- To explain public policy and its operations with special focus on policy relating to Government finance.
- To analyze and evaluate the impact of the public policy on firms and economy at large.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the importance of public systems in a fast-changing environment in the global context.	L4	Analyze
CO2	Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.	L2	Understand
CO3	Explain public policy and its operations with special focus on policy relating to Government finance.	L4	Analyze
CO4	Analyze the impact of public policy on firms and the economy at large and work under various fields as policymakers.	L3	Apply
CO5	Apply analytical skills through Expenditure Policy in public services case studies.	L5	Evaluate

Public Systems and Policies (OEET70410)

COURSE CONTENTS

Unit-I **9 Hrs.**

Introduction and Overview of Public Systems: Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.

Unit-II **6 Hrs.**

Public Sector in the Economics Accounts: Public Sector in the circular flow; Public Sector in the National Income Accounts.

Unit-III **7 Hrs.**

Public Choice and Fiscal Politics: Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

Unit-IV **11 Hrs.**

Introduction and Overview of Public Policy: Markets and Government; Social goods and Market failure, public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal and Budgetary Policy, Fiscal Federalism in India.

Unit-V **9 Hrs.**

Case Studies in Expenditure Policy: Public Services: A) National Defence B) Highways C) Outdoor Recreation D) Education.

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W. W. Norton and Company, 2011.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall, 2008.
3. Anderson J.E.,"Public Policy-Making: An Introduction", Boston, 2011.
4. Avasthi and Maheshwari, "Public Administration", Lakshmi Narain Agarwal, 2008.
5. Mohit Bhattacharya, "New Horizons of Public Administration", Jawahar Publishers, New Delhi, 2011.
6. Nicholas Henry,"Public Administration and Public Affairs", Prentice Hall of India, 2017.
7. Harvey S Rosen and Ted Gayer, "Public Finance", 10th Edition, McGraw-Hill Education, 2013.
8. Richard A. Musgrave and Peggy B. Musgrave, "Public Finance in Theory and Practice", 5th Edition, McGraw Hill, 2017.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
IoT and Sensor Network Laboratory (PCET7050L)	

Course Objectives:

- To learn IoT and Sensor Network systems.
- To learn IoT and Sensor Network techniques.
- To Analyze IoT in terms of a suggested IoT conceptual framework.
- To learn initiatives of international organizations for design standardization of IoT/M2M architectural layers and domains.
- To provide working experience in various Hardware / Software programming techniques.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify different components of an IoT and Sensor network system.	L3	Apply
CO2	Designing and affordability of IoT devices.	L6	Create
CO3	Explore the Industrial IoT, Industry 4.0, Connected Car applications.	L4	Analyze
CO4	Use Internet of Things for real time applications.	L3	Apply

IoT and Sensor Network Laboratory (PCET7050L)

COURSE CONTENTS

Unit-I **Introduction** **6 Hrs.**

Internet of Things an overview, IoT Conceptual framework, IoT architectural View, Technology be- hind IoT, Sources of IoT, M2M Communication, and Examples of IoT.

Unit-II **Design Principles for Connected Devices** **4 Hrs.**

IoT/M2M systems Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation, and device management, Designing and affordability, Energy efficiency in IoT.

Unit-III **Design Principles for Web Connectivity** **4 Hrs.**

Introduction, Web communication protocol for connected devices, Message communication protocols for connected devices, Internet based communication, IP addressing in the IoT.

Unit-IV **Data Acquiring, Organizing, Processing and Analytics** **8 Hrs.**

Data acquiring and storage, Organizing the data, Transactions, Integration and Enterprise systems, Acquiring, Managing and storing processes.

Unit-V **Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks** **6 Hrs.**

Sensor technology, Industrial IoT and Automotive IoT, Actuator, Sensor data communication protocols, Wireless sensor networks technology, Embedded Computing Basics, Embedded Platforms for prototyping.

IoT and Sensor Network Laboratory (PCET7050L)

List of Laboratory Experiments: (Any Eight)

1. LED Blink and Pattern.
2. 7 Segment Display.
3. Push Button.
4. LED Pattern with Push Button Control.
5. Push Button Counter.
6. LM35 Temperature Sensor.
7. Analog Inputs.
8. Analog Input Digital Output
9. IR Sensor Analog Input.
10. LCD 16X2 Display.
11. IR Sensor Based Security System.
12. Night Light Controlled Monitoring System.
13. Analog Input Analog Output.
14. LM35 Temperature Sensor with Fire Alarm.

Text Books

1. Raj Kamal, Internet of Things Architecture and Design Principles, Tata McGraw Hill, 2017.
2. Colin Dow, Internet of Things Programming Projects: Build modern IoT solutions with the Raspberry Pi 3 and Python, 2018, Packt Publishing.
3. Constandinos X. Mavromoustakis, George Mastorakis, Jordi Mongay Batalla, Internet of Things (IoT) in 5G Mobile Technologies, 2016, Springer International Publication.

Reference Books

1. Fadi Al-Turjman, Artificial Intelligence in IoT, 1st Edn, Springer International Publishing.
2. Shampa Sen, Leonid Datta, Sayak Mitra, Machine Learning and IoT: A Biological Perspective, 2019 CRC Press.
3. Anand Tamboli, Build Your Own IoT Platform: Develop a Fully Flexible and Scalable Internet of Things Platform in 24 Hours, 2019 Apress.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Industrial Automation Laboratory (PCET7060L)	

Course Objectives:

- To learn Industrial automation and various systems.
- To learn Industrial automation techniques.
- To identify the differences between PLCs, SCADA, DCS.
- To provide the skills to install and trouble shoot Automation systems.
- To provide working experience in various programming techniques.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify various components and status indications of automation systems and PLCs used in industrial and daily life applications.	L2	Understand
CO2	Simulate input/output devices with appropriate PLC modules using ladder diagrams.	L4	Analyze
CO3	Develop and test ladder programs for a variety of automation applications using PLC simulation software.	L3	Apply
CO4	Design simple SCADA mimic diagram for basic industrial process monitoring.	L6	Create

Industrial Automation Laboratory (PCET7060L)

COURSE CONTENTS

Unit-I **Introduction** **4 Hrs.**

Need and benefits of Industrial Automation, Basic components of automation system, Types of automation, Fixed, Programmable, Flexible, Different systems used for Automation i.e., PLC, HMI, SCADA, DCS, Drives.

Unit-II **Programmable Logic Controller (PLC)** **6 Hrs.**

Introduction, Block diagram, memory organization, IO modules (discrete and Analog), I/O modules selection criteria, Fixed and Modular PLC, PLC selection, PLC Installation, Advantage, Application.

Unit-III **PLC Programming** **6 Hrs.**

I/O addressing, Programming instructions (Relay, Timer, Counter, Delay, Logical, Data Handling, Comparison), Functional Block Diagram (FBD), Ladder Programming.

Unit-IV **Supervisory Control and Data Acquisition System (SCADA)** **6 Hrs.**

Introduction, Architecture/Block diagram, editors of SCADA, Interface SCADA with PLC, create SCADA screen for simple object, Application of SCADA like Traffic light control, water distribution, Industrial PCs, Mini Rugged PCs, Industrial Open Frame Panel PCs.

Unit-V **Distributed Control System (DCS)** **6 Hrs.**

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Advantages of DCS.

Industrial Automation Laboratory (PCET7060L)

List of Laboratory Experiments: (Any Eight)

1. Develop/Execute ladder diagram using timer, counter, logical and arithmetic instructions.
2. Use PLC to control the devices, lamp, motor switches, sensors
3. Measure Temperature of the given liquid using RTD or Thermocouple and PLC.
4. Design ladder diagram for Blink LEDs
5. Design ladder diagram for sequential control of DC motor.
6. Develop and test ladder program for pulse counting using switch/ proximity sensor.
7. Use various functions of SCADA simulation editors to develop simple project.
8. Develop SCADA mimic diagram for water tank level control.
9. Industrial PC based control system.
10. Identify various automation systems available in different appliances/devices/machines in day- to-day use.
11. Identify various parts and front panel status indications of the given PLC.

Text Books

1. Petruzella F. D, Programmable Logic Controller, 4th Edn, Tata McGraw Hill.
2. Mitra Madhuchandra, Sengupta, Programmable logic controller and industrial automation, 5th Edn, Penram International Publication.
3. Bhoyar S A, Supervisory control Data acquisition, 4th Edn, ISA Publication.
4. Stenerson John, Industrial Automation Process Control, 1st Edn, Pearson Publication.

Reference Books

1. S.K. Singh, Industrial Instrumentation and Control, 2nd Edn, Tata McGraw Hill.
2. Richard L. Shell, Handbook of Industrial Automation, 1st Edn, CRC Press.
3. Bailey, David, Practical SCADA for Industry, 1st Edn, New nes international Publication.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Project Stage - II (PJET7070L)	

Course Objectives:

- To implement the solution as per the problem statement.
- To develop the team building, writing, logical reasoning and management skills.
- To provide the connections between the designs and concepts across different disciplinary boundaries.
- To encourage students to become independent personnel, critical thinkers and lifelong learners

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tool and method.	L2	Analyze
CO2	Demonstrate project-based learning that allows students to transfer existing ideas into new applications.	L3	Apply
CO3	Develop an ability to work in teams and manage the conduct of the research study.	L3	Apply
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L2	Apply
.CO5	Present the research in the form of technical writing, understand what constitutes to plagiarism and how to	L2	Apply

Project Stage - II (PJET7070L)

COURSE CONTENTS

Syllabus:

- Project-I work done in VI semester shall be continued as Project-II in semester VII.
- Students should complete remaining implementation of ideas given in synopsis/Abstract of semester VII.
- Students / group must plan their execution of project, so that project work should be completed before end of semester.
- Project-II involves fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing, possible results and report writing.
- Each project group is required to maintain log book for documenting various activities of Project- II and submit group project report at the end of Semester-VII in the form of Hard bound.

Domain knowledge (any beyond) needed from the following areas for the effective implementation of the project:

Microcontroller and Embedded Systems, Signal Processing, Microwave and Antennas, Networking and Internet of Things, Data science and big data, Communication, Web and Application development, Robotics, AI and Machine learning. The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines:

The main purpose of this activity is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

- Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
- In the first review of this semester, each group is expected to complete 30 % of project.
- In the second review of this semester, each group is expected to complete 50 % of project.
- Interaction with alumni mentor will also be appreciated for the improvement of project.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project stage I (at the end of the semester) will be done by the departmental

committee (including project guide).

- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details
- Project stage I Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Table 1: Log Book Format

Sr. No	Week (Start Date: End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Sheet

Sr No	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Table 3: Evaluation Sheet

Sr No	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	PCB/ hardware/ programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings

- Validation of results

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TA ensures the satisfactory performance on the above aspects.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Wireless Network (PEET8011T)	

Pre-requisite:

- Computer Networks
- Digital Communication
- Mobile Communication

Course Objectives:

- To understand architecture concept of wireless transmission and spectrum requirement.
- To understand the concepts of WPAN, WLAN and WSN.
- To understand type 1 and type 2 applications of WSN.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamentals, architecture, design issues and standards and spectrum of various wireless network and compare them.	L2	Understand
CO2	Compute different parameters of wireless networks.	L3	Apply
CO3	Evaluate various wireless systems and deduce some conclusion.	L5	Evaluate
CO4	Simulate various wireless systems using different simulation softwares.	L4	Analyze

Wireless Network (PEET8011T)

COURSE CONTENTS

Unit-I **Basics of Wireless Networks** **5 Hrs.**

Introduction to Wireless Network, Classifications of wireless networks, Wireless Standards, Spectrum requirement for various wireless systems.

Unit-II **Wireless Personal Area Networks** **10 Hrs.**

WPAN: Bluetooth (802.15.1): Radio Specifications, Protocol Stack, Link Types, Security, Topologies, ZigBee (802.15.4): Radio Specifications, Components, Topologies, Protocol Stack, Applications. RFID: Radio Specifications, Architecture Types, Near Field Communication UWB (802.15.3 a): Introduction and working.

Unit-III **Wireless Local Area Network and Wireless Metropolitan and Wide Area Networks** **8 Hrs.**

Introduction and features of IEEE802.11a, b, I, g and n Equipment, Topologies, Technologies, Applications, IEEE802.11 WLAN Joining an existing Basic Service Set, Security and Power Management, Radio Link and Coverage Planning for IEEE 802.11 WLAN Case Study: Campus Wi-Fi installation.

Unit-IV **Wireless Sensor Network** **8 Hrs.**

Background of sensor network technology, sensor network architectural elements, historical survey of sensor networks, Technologies for wireless sensor network, sensor node technology, hardware and software, sensor taxonomy, operating environment, wireless network trends, transmission technology.

Unit-V **Applications of Wireless Sensor Network** **6 Hrs.**

Applications of wireless sensor network, range of applications, examples of category 1 and 2 Case Study: Any one application of sensor network Wireless Body Area Network: Properties, Network Architecture, Network Components, Applications.

Unit-VI **Middleware for Wireless Sensor Networks** **5 Hrs.**

Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware

Text Books

1. Vijay K. Garg, Wireless Communication and Networking, Morgan, 2010, Kaufmann Series in Networking, Elsevier.

2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, Wireless Sensor Networks: Technology, Proto- cols, and Applications, 2007, John Wiley Sons.
3. Sunil Kumar, S. Manvi, and Mahabaleshwar S. Kakkasageri, Wireless and Mobile Networks Concepts and Protocol, 2010, Wiley Publication.
4. Raj Kamal, Internet of Things Architecture Design Principles, 2017, McGraw Hill.

Reference Books

1. Upena Dalal, Wireless and Mobile Communications, 2016, Oxford University Press.
2. Theodore S. Rappaport, Wireless communications principles and practice, 2nd Edn, Pearson Publication.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Satellite Communication (PEET8012)	

Pre-requisite:

- Analog Communication
- Digital Communication

Course Objectives:

- To understand the basics of satellite communications and different satellite communication or bits.
- Provide an in-depth understanding of satellite communication system operation, launching techniques, satellite link design and earth station technology.
- To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
- Review the state of the art in new research areas such as satellite networking, satellite personal. Communications, mobile satellite communication, Laser satellite.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamentals of satellite communication systems, orbital mechanics, wave propagation, and launching techniques.	L2	Understand
CO2	Apply the concepts of satellite subsystems and stabilization techniques in the space segment.	L3	Apply
CO3	Apply design considerations and working principles of earth station components including antenna, tracking system, LNA, and HPA.	L3	Apply
CO4	Analyze satellite link parameters including link budget, noise, C/N ratio, uplink and downlink performance under various losses and conditions.	L4	Analyze
CO5	Apply multiple access techniques and satellite applications such as VSAT, TDMA, FDMA, CDMA, and optical satellite communication systems.	L3	Apply

Satellite Communication (PEET8012)

COURSE CONTENTS

Unit-I Overview of Satellite Systems, Orbits and Launching 8 Hrs.

Frequency allocation for satellite communication, Polar orbiting satellites, Kepler ‘s Laws, orbital parameters, orbital perturbations, effects of a non-spherical earth, atmospheric drag. Wave Propagation Polarization, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Antenna Polarization, Polarization of Satellite signals. Sub-satellite Point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage. Selection of launching site, launch window, launch vehicles; satellite launch vehicle (SLV), augmented satellite launch vehicle (ASLV), polar SLV, geostationary satellite launch vehicle (GSLV).

Unit-II Space Segment 8 Hrs.

Satellite subsystems: Transponder sub-system, Antenna subsystem, AOC Sub-system, TTC Sub- system, power sub-system, Thermal sub-system, reliability and quality Assurance. Satellite stabilization, stabilization techniques.

Unit-III Earth station 8 Hrs.

Design consideration, General configuration- Block diagram, receive only type earth, transmit-receive type earth station. Antenna system, Feed system, Tracking system, LNA, HPA.

Unit-IV Satellite Link 10 Hrs.

Isotropic radiated power, transmission losses, free-space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionospheric losses, link power budget. System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier to noise ratio. Uplink: Saturation flux density, input back off, earth station HPA, Downlink: Output back off, satellite TWTA output. Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio, inter-modulation noise.

Unit-V The Space Segment Access and Utilization 8 Hrs.

Space segment access methods, pre-assigned FDMA, demand assigned FDMA, SPADE system. Code Division Multiple Access: Direct-sequence spread spectrum– acquisition and tracking TDMA: Reference Burst; Preamble and Post amble, carrier recovery, frame efficiency, channel capacity, preassigned TDMA, demand assigned TDMA. Satellite Applications: VSAT systems: Advantages, configurations, frequency bands, Television broadcast systems, DAB, Laser Satellite Communication: Link analysis, optical satellite link

transmitter, optical satellite link receiver, satellite beam acquisition, tracking positioning, deep space optical communication link.

Text Books

1. Dennis Roddy, “Satellite Communications”, Mc. Graw-Hill International,4th Edition, 2019.
2. M. Richharia, “Satellite Communication Systems Design Principles”, Macmillan Press Ltd, 2nd Edition, 2003.
3. R. N. Mutangi, “Satellite Communication”, Oxford university press, 1st, Edition, 2016.
4. Gerard Maral and Michel Bousquet, “Satellite Communication Systems”, Wiley Publication, 4th, Edition, 2018.

Reference Books

1. Gerard Maral, “VSAT Networks”, John Willy Sons, 2nd Edition, 2004.
2. Timothy Pratt, Charles Bostian, and Jeremy Allmuti, Satellite Communications, 1st Edn, John Willy Sons.
3. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, Satellite Communication Systems Engineering, 2nd Edn, Pearson Publication.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Advanced Digital Signal Processing (PEET8013T)	

Pre-requisite:

- Signals and Systems
- Digital Signal Processing
- Engineering Mathematics

Course Objectives:

- Understand Multirate Signal Processing, Power Spectrum Estimation, Adaptive Filtering and Wavelet Transform.
- Apply signal processing to real world problems.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate an understanding of Multirate sampling and its mechanism.	L2	Understand
CO2	Apply the techniques of power spectrum estimation and wavelet theory for various applications.	L3	Apply
CO3	Implement adaptive filters for given applications.	L3	Apply
CO4	Apply Wavelet Transform to Signal/Image Processing.	L4	Apply

Advanced Digital Signal Processing (PEET8013T)

COURSE CONTENTS

Unit-I **Multirate Digital Signal Processing** **6 Hrs.**

Advantages of Multirate Signal Processing, Interpolation and Decimation, Sampling Rate Conversion by Non-Integer Factor.

Unit-II **Power Spectrum Estimation** **10 Hrs.**

Non-Parametric Method of Power Spectrum Estimation: Period gram, Modified Period gram, Barlett Method, Welch's Method, Blackman-Tukey Approach Parametric Methods of Power Spectrum Estimation: Regressive Spectrum Estimation, Model Parameters-Yule-Walker Equation, Least Square Method and Linear Prediction, Moving Average Spectrum Estimation, Autoregressive Moving Aver- age Spectrum Estimation.

Unit-III **Linear Prediction and Optimum Linear Filters** **10 Hrs.**

Representation of Stationary Random Process, Forward and Backward Linear Prediction, Solution of Normal Equation (Levinson-Durbin and Schur Algorithm), AR Lattice and ARMA Lattice Ladder Filters, Weiner Filters for Filtering and Prediction.

Unit-IV **Adaptive Filters** **10 Hrs.**

Applications of Adaptive Filters: System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation, Adaptive Algorithms: LMS Algorithm, RLS Algorithm

Unit-V **Wavelet Transform** **6 Hrs.**

Introduction to Time Frequency Analysis, Short Time Fourier Transform, Continuous Wavelet Trans- form, Discrete Wavelet Transform, Multiresolution Analysis. Applications.

Text Books

1. John G. Proakis, and Dimitris G. Monolakis, Digital Signal Processing, 2007, Prentice Hall India.
2. Emmanuel C. Ifeachor, and Barrie W. Jervis, Digital Signal Processing A Practical Approach, 2008, Pearson Education.

Reference Books

1. Simon Haykin, Adaptive Filter Theory, 2013, Pearson Education.
2. Tarun Kumar Rawat, Digital Signal Processing, 3rd Edn, Oxford University Press.
3. Raghuveer M. Rao and Ajit S. Bopardikar, 2000, Wavelet Transforms, Introduction to Theory and Applications, Pearson Education Asia.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Microwave Integrated Circuits (PEET8014T)	

Pre-requisite:

- Microwave Engineering
- Electromagnetic Wave and Propagation
- Electronic Devices & Circuits

Course Objectives:

- To understand the integration of microwave devices in the form of IC.
- To understand the basic principles of micro strip line and coplanar waveguide.
- To design amplifier and oscillator for various applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Differentiate between HMIC and MMIC.	L4	Analyze
CO2	Analyze the transmission lines used at microwave frequencies.	L4	Analyze
CO3	Design the microwave amplifier for the given specifications.	L6	Create
CO4	Design the microwave oscillator.	L6	Create

Microwave Integrated Circuits (PEET8014T)

COURSE CONTENTS

Unit-I **Hybrid MICs and Monolithic MICs** **8 Hrs.**

Definition, characteristics, comparison with conventional circuits, field of application and limitations and criteria for the choice of substrate material in HMICS and MMICS. Thin film hybrid circuits, thick film hybrid circuits, art work, masking, photolithography, resistor stabilization, sawing, brazing process, wire bonding. Monolithic MICs: Doping by ion implantation, Ohmic contacts, metal resistive layers, gate metal, dielectric and air-bridge vias, wafer process steps.

Unit-II **Microstrip Lines** **8 Hrs.**

Planar wave guides, non-TEM propagation, line impedance definitions, quasi-static approximations, quasi-static line parameters. Microstrip open circuits and gaps, micro strip corners, step change in width. Dispersion analysis, micro strip characteristic impedance, symmetric-T junction, green's functions, millimeter wave modelling of micro strip lines.

Unit-III **Coupled Line Propagation** **8 Hrs.**

Coupled line propagation: wave equations for coupled lines, propagation models, coupled line parameters, coupled line parameter variations with frequency, directional couplings, Lange coupler, coupled line pair operated as a four port. Coplanar wave guides: design considerations and coplanar line circuits.

Unit-IV **Microwave Amplifier Design** **10 Hrs.**

Introduction, Definitions of Two-Port Power gains, derivation of power gains, stability circles, Test for unconditional stability. Single-stage Transistor amplifier design: Maximum gain (Conjugate Matching), constant-gain circles and design for specified gains, Low noise amplifier design. Broadband transistor amplifier design: Balanced amplifier, Distributed amplifiers, differential amplifiers. Power amplifiers, amplifier linearization methods, design of class A power amplifiers.

Unit-V **Microwave Oscillator Design** **8 Hrs.**

Introduction, compressed smith chart, resonators, single and two-port oscillator design, negative resistance from transistor model. Noise in oscillators: linear approach, analytical approach to optimum oscillator design using s parameters, nonlinear active models for oscillators.

Text Books

1. D. M. Pozar, Microwave Engineering, John Wiley & Sons Publication, 2013.
2. M. M. Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education, 2007
3. D. H. Schrader, Microstrip Circuit Analysis, Prentice Hall PTR, New Jersey.

Reference Books

1. K. C. Gupta, R. Garg and I. J. Bahl, Microstrip Lines and Slot Lines, Artech House.
2. D. Vendelin, A. M. Pavio, and U. L. Rohde, Microwave Circuit Design, John Wiley & Sons Publication.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Optical Communication (PEET8021T)	

Pre-requisite:

- Analog Communication
- Digital Communication
- Electromagnetic Wave and Propagation

Course Objectives:

- To understand and analyse Optical fibre structures wave guide, fabrication and signal degradation in fiber.
- To understand and analyse the characteristics of optical sources and detectors.
- To design optimal optical links by using Link budget and rise time budget and understand basic concepts of optical networks.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze propagation of light in optical fiber in different fiber types using the ray theory and electromagnetic mode theory.	L4	Analyze
CO2	Analyze transmission characteristics (attenuation / dispersion/Nonlinearity) of an optical fiber using different techniques.	L4	Analyze
CO3	Compare and contrast working principle of different optical sources, detectors and analyze performance of different receiver structures.	L4	Analyze
CO4	Summarize different fiber optic components and demonstrate the use of them in optical link.	L3	Apply
CO5	Design optical fiber communication links by evaluating different system considerations and understand basic concepts of optical networks and scope of free space optics.	L6	Create

Optical Communication (PEET8021T)

COURSE CONTENTS

Unit-I **Optical Fiber Fundamentals** **10 Hrs.**

Motivations for light wave communications, General Optical system block diagram, advantages, dis- advantages and applications of optical fiber communication, Loss and bandwidth window optical fiber waveguides, Ray theory, Electromagnetic waves, Modes in a planar waveguide, Phase and group velocity, Types and classification of optical fibers

Unit-II **Transmission Characteristics of Optical Fiber** **10 Hrs.**

Attenuation, absorption, linear and nonlinear scattering losses, bending losses, dispersion, Chromatic dispersion, Intermodal dispersion, over all dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, OTDR. Non-linear effects, scattering effects, Kerr effects, soliton.

Unit-III **Optical Sources and Detectors** **8 Hrs.**

Working principle and characteristics of sources (LED, LASER), Tuneable lasers, Quantum well lasers, Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers. Working principle and characteristics of detectors (PIN, APD), Material requirement for RCEPD, Resonant cavity enhancement (RCE) Photo Detector, receiver structure, bit error rate of optical receivers and receiver performance

Unit-IV **Optical Communication Components** **6 Hrs.**

Fiber joints, fiber connectors, splices Couplers, Isolators, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types (EDFA and SOA).

Unit-V **Optical Networks and Free Space Optics** **8 Hrs.**

Point-to-Point links, system considerations, Link Power budget, Rise time budget, SONET/SDH optical networks, WDM and DWDM optical networks. Introduction to FSO, Applications, Comparison with microwave systems, coherent optical space communication, Drawback and problems of realization, system description and design.

Text Books

1. John M. Senior, Optical Fiber Communications, 3rd Edn, Pearson Education.
2. JH Franz, VK Jain, Optical Communications Components and systems, 2013, Narosa.
3. Gerd Keiser, Optical Fiber Communication, 4th Edn, MGH.

Reference Books

1. Harold Kolimbiris, Fiber optics communications,2007, Pearson Education
2. Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks: A Practical Perspective, 3rd Edn, Elsevier India Pvt. Ltd.
3. Ghatak and K. Thyagrajan, An introduction to fiber optics, 2010, Cambridge Univ Press.
4. Joseph C Palais, Fiber Optic Communication, 4th Edn, Pearson Education.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
5G Technology (PEET8022T)	

Pre-requisite:

- Mobile Communication
- Digital Communication

Course Objectives:

- To learn the Basics of 5G and Beyond Wireless communication
- To provide a basic understanding of the key technologies and modulation techniques of 5G
- To study architecture of 5G.
- To develop the concepts of spectrum requirements, MIMO, antennas for 5G.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basics of 5G and beyond communication.	L2	Understand
CO2	Characterize and analyze various modulation and multiplexing techniques used in 5G.	L4	Analyze
CO3	Elaborate system architecture of 5G technology.	L2	Understand
CO4	Illustrate spectrum requirement, antenna design and radio propagation for 5G technology.	L2	Understand
CO5	Design security architecture of 5G.	L6	Create

5G Technology (PEET8022T)

COURSE CONTENTS

Unit-I **Introduction** **6 Hrs.**

Introduction – Historical trend of wireless communication – Evolution of LTE Technology to Beyond 4G.THE 5G INTERNET – Internet of Things and context – Awareness – Network Reconfiguration and Virtualization support – Mobility – quality of Service Control – Emerging approach for resource over provisioning the 5G radio-access technologies-OFDMA, NOMA, SCMA, IDMA

Unit-II **Architecture of the Core Network** **8 Hrs.**

The Evolved Packet Core - Release 8 Architecture. Control and User Plane Separation The 5G Core Network- Representation Using Reference Points, Representation Using Service-based Interfaces, Data Transport, Roaming Architectures, Data Storage Architectures, Non-3GPP Access to the 5G Core. Network Areas, Slices and Identities-Signaling Protocol, Signaling Protocol Architecture

Unit-III **Architecture of the Radio Access Network** **8 Hrs.**

The Evolved UMTS Terrestrial Radio Access Network – 3GPP Architecture, Carrier Aggregation, Dual Connectivity the Next-generation Node B - High Level Architecture, Internal Architecture and Deployment Options. Network Areas and Identities - Tracking Areas, RAN Areas, Cell Identities. Signalling Protocols - Signalling Protocol Architecture, Signalling Radio Bearers

Unit-IV **MIMO systems and Communication Devices** **6 Hrs.**

Introduction, MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Fundamentals of baseband and RF implementations in massive MIMO.

Device To Device D2D Communication – D2D: from 4G to 5G – Radio resource management for mobile brand D2D – Multihop D2D communications for proximity and emergency services – Multi-operator D2D communications.

Unit-V **Spectrum, Antennas and Radio Propagation** **8 Hrs.**

Spectrum - Spectrum landscape and requirements, Spectrum Allocations for 5G, Bandwidth requirements, Spectrum access modes and sharing scenarios, Spectrum technologies-Spectrum toolbox, Main technology component.

Antennas - Antennas and Propagation, Antenna Gain Radio Propagation - Radio Propagation Issues for Millimetre Waves, Diffraction and Reflection, Penetration Losses, Foliage Losses, Atmospheric Losses, Multipath, Fading and Coherence, Introduction, Angular Spread and Coherence Distance, Doppler Spread and Coherence Time.

Unit-V **Security and Applications of 5G** **6 Hrs.**

Security Issues and Challenges in 5G Communications Systems. Mobile Malware Attacks Targeting UE. Access Networks, User Equipment and External IP Networks - Attacks on 5G Access Network. HeNB Femtocell Attack. Mobile Operator's Core Network. 5G Applications and Future Scope.

Text Books

1. Christopher Cox, Chris Cox, An Introduction to 5G: The New Radio, 5G Network and Beyond, 1st Edn, John Wiley & Sons Ltd.
2. Afif Osseiran, Jose F. Monserrat, Patrick Marsch 5G Mobile and Wireless Communications Technology, 1st Edn, Cambridge University Press.

Reference Books

1. Raj Kamal, Internet of Things Architecture and Design Principles, 2017, McGraw Hill Education (India) Private Limited.
2. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, 2015, Wiley publication.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Internet Engineering & Network Security (PEET8023T)	

Pre-requisite:

- Computer Networks

Course Objectives:

- To understand on Internet protocol, standards, services and administration.
- To discuss voice over IP as a real-time interactive audio/video service.
- To introduce various techniques to implement security mechanisms for network and cyber security.
- To discuss security implications on Organizations with the help of Risk Management and Incident preparation.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Configure various application layer protocols.	L3	Apply
CO2	Analyze services of network layer provided by advanced protocols.	L4	Analyze
CO3	Compare and analyze various audio and video digitization and compression mechanism and explain voice over IP in the context of real-time interactive audio/video service.	L4	Analyze
CO4	Describe security threats and apply security techniques using cryptosystems.	L3	Apply
CO5	Describe different network security mechanisms.	L2	Understand
CO6	Analyze different types of firewalls, IDS and system security mechanisms.	L4	Analyze

Internet Engineering & Network Security (PEET8023T)

COURSE CONTENTS

Unit-I **Introduction to Internet and Application layer protocols** **8 Hrs.**

What is the Internet, Evolution of the Internet, Review of TCP IP layer functions Application Layer protocols: HTTP, DHCP, DNS, FTP, TFTP, SMTP, MIME, IMAP, POP3, TELNET, SSH

Unit-II Network Layer 4 Hrs.

IPv6, Packet format, Transition from IPv4 to IPv6, ICMP (v4 and v6) Review of IP addresses, Special addresses, NAT, CIDR: Address aggregation

Unit-III Multimedia Communication 8 Hrs.

Digitizing audio and video, Audio Compression, video compression, streaming stored audio / video Characteristics of real time interactive audio/video, RTP, RTP Packet format, UDP Port, RTCP, RTCP messages VOIP: SIP, H.323 Flow characteristics, Flow classes, techniques to improve QoS, resource reservation, admission control

Unit-IV Security in Networks 10 Hrs.

Introduction to Information Security, Network Security Domains, Attacks and Their classification, Security services and mechanisms Network security basics, Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange. Web Security Requirements, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Electronic Transaction (SET).

Unit-V Firewalls IDS and system security 6 Hrs.

Designing and Configuring Firewall Systems, Firewall Components Firewalls – Types, Comparison of Firewall Types, Firewall Configurations. Installing and Configuring FW, Proxy Server, Honey pot, Digital Immune System.

Unit-VI System security and case study 6 Hrs.

Signature verification, Finger print recognition, Voice recognition, Iris Recognition system. Security Operations Centre (SOC), Network Operations Centre (NOC), Network Security Audit Cloud Security. Wi-Fi Security, Mobile and Cellular Security.

Text Books

1. B. Forouzan, TCP/IP Protocol Suite, 4th Edn, McGraw Hill Publication.
2. B. Forouzan, Cryptography and Network Security, McGraw Hill Publications, 2010.
3. Nina Godbole, Cyber Security by John Wiley Publications, 2011.

Reference Books

1. Leon Garcia, Communication Networks by, 2nd Edn, McGraw-Hill Publication.
2. Kurose and Ross, Computer Networking by, 5th Edn, Pearson Publication.

3. P.fleeger and P.fleeger, Security in Computing, 5th Edn, Pearson Publications.
4. M. Whitman, Management of Information Security, 4th Edn, Cengage Publications
5. B. Menezes, Network Security and Cryptography, 1st Edn, Cengage Learning India

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Machine Learning for Signal Processing (PEET8024T)	

Pre-requisite:

- Signals and Systems
- Digital Signal Processing

Course Objectives:

- Introduce students to the fundamentals of machine learning (ML) techniques useful for various signal processing applications.
- To discuss various mathematical methods and algorithms involved in ML for Signal Processing.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamental concepts of linear algebra, probability theory, and digital signal processing relevant to machine learning.	L2	Understand
CO2	Apply linear regression techniques such as least squares, maximum likelihood estimation, and regularization to solve signal processing problems.	L3	Apply
CO3	Analyze and implement linear classification models including least squares classification and perceptron algorithms for signal processing tasks.	L4	Analyze
CO4	Design and develop non-linear models using neural networks with optimization and regularization techniques.	L6	Create
CO5	Analyze probabilistic models such as k-means clustering and Gaussian Mixture Models using Expectation-Maximization algorithms.	L4	Analyze
CO6	Design and develop machine learning models for real-world applications including audio classification, speech recognition, and image processing.	L6	Create

Machine Learning for Signal Processing (PEET8024T)

COURSE CONTENTS

Unit-I Refresher Topics 6 Hrs.

Linear Algebra: Vectors, Matrices and Tensors, Linear Dependence and Span, Norms, Eigen de- composition, Singular Value Decomposition. Probability Theory: The Chain Rule of Conditional Probabilities, Independence and Conditional Independence, Expectation, Variance and Covariance, Bayes' Rule. Digital Signal Processing: Audio Acquisition, Representation and Storage, Image and Video Acquisition, Representation and Storage.

Unit-II Linear Models for Regression 6 Hrs.

Polynomial Curve fitting, Maximum likelihood and least squares, Geometry of least squares, Sequential learning, Regularized least squares, Multiple outputs.

Unit-III Linear Models for Classification 6 Hrs.

Two class Classification, Multiclass Classification, Least Squares for Classification, Problems with Least Squares Loss, Perceptron Algorithm.

Unit-IV Non-Linear Models-Neural Networks 8 Hrs.

Non-Linear Regression, Parameter Optimization, Gradient descent Optimization, Evaluation of error- function derivatives, A simple example, Efficiency of backpropagation. Regularization for Neural Net- works: Data set Augmentation, Early Stopping, Bagging, Dropout.

Unit-V Probabilistic models and Expectation Maximisation Algorithm 8 Hrs.

k-means clustering, Gaussian Mixture Model, Maximum likelihood for Gaussian Mixtures, EM for Gaussian Mixtures.

Unit-VI Machine Learning for Audio Classification 8 Hrs.

Time Series Analysis, LSTMs and CNNs. Machine Learning for Speech Recognition: Hidden Markov Models, Finite State Transducers and Dynamic Programming. Machine Learning for Image Processing: Transfer Learning, Attention models, Attribute-based learning.

Text Books

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, 2006, Springer.
2. Francesco Camastra, Machine Learning for Audio, Image and Video Analysis, 2007, Springer.
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, 1st Edn, The MIT Press.

Reference Books

1. Christopher M. Bishop, Neural Networks for Pattern Recognition, 1995, Clarendon Press, Ox- ford.
2. Tom M. Mitchell, Machine Learning,1997, McGraw-Hill.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
Internship (INTET8030L)	

Course Objectives:

- To get exposure of industrial ecosystem.
- To enhance student's knowledge in the particular technology.
- To nurture student's leadership ability and responsibility to perform or execute the given task individually or in team.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply theoretical knowledge to real-world engineering problems through hands-on experience in industry or field settings.	L3	Apply
CO2	Apply technical knowledge and problem-solving approaches to address complex engineering problems in an industrial environment.	L3	Apply
CO3	Analyze organizational structures, workflows, and technologies to understand industry practices and operational challenges.	L4	Analyze
CO4	Develop technical documentation, reports, and presentations reflecting experiential learning and problem-solving approaches.	L6	Create
CO5	Discuss career goals and identify areas for personal and professional development based on internship exposure.	L2	Understand

GUIDELINES

Internships offer valuable educational and career development opportunities by providing students with practical experience in their field of study. In Semester – VIII, students have two options for their internship: Industry Internship and In-house Internship.

A. Industry Internship

Objectives: The industry internship aims to achieve the following objectives

1. Expose technical students to the industrial environment, allowing them to gain real-world experience and develop into competent professionals.
2. Provide opportunities to learn and enhance the practical technical skills required for professional roles.
3. Familiarize students with current technological developments relevant to their field of study.
4. Encourage the application of technical knowledge in real industrial situations.
5. Develop skills in writing technical reports and projects.
6. Introduce students to the responsibilities and ethics of the engineering profession.
7. Familiarize students with various materials, processes, products, and quality control practices.
8. Promote academic, professional, and personal growth.
9. Facilitate connections between students and potential future employers.
10. Foster an understanding of the social, economic, and administrative factors influencing industrial organizations and their working environments.
11. Develop an understanding of worker psychology, habits, attitudes, and problem-solving approaches.

Industry Internship Guidelines:

The Training and Placement (T&P) cell of the institute will arrange internships for students in industries/organizations after the seventh semester.

Students are expected to accept internship offers regardless of the company, job profile, location, or stipend offered.

Alternatively, students can individually apply by submitting “Student Internship Program Application” (available on Institute Website) for industry internships, adhering to the prescribed guidelines as follows:

1. Only T&P department granted internship will be considered.
2. The internship duration should be of minimum 12 Weeks.
3. Each student needs to take prior permission from T&P department before proceeding for any internship opportunity on his/her own.

4. Each student will be monitored twice (virtually/through online meetings) during the internship period in the presence of an industry mentor and the departmental faculty mentor and the concerned TPC.
5. If any student wants to withdraw from the Internship, he/she can only be allowed within two weeks of joining the same. Such students will have to continue the semester VIII academic activities regularly along with In-house internship.

Expected Activity in Industry Internship

Students may choose either to work on innovation or entrepreneurial activities resulting in start-ups or undergo internship with Industry/NGO/ Government organizations/Micro/ Small/ Medium enterprises to make themselves ready for the industry.

Every student is required to prepare a file containing documentary proofs of the activities done by him / her. The evaluation of these activities will be done twice (virtually/through online meetings) during the internship period by the committee constituted by the Head of the Department which shall include an industry mentor, faculty mentor and Department TP Coordinator (TPC). The assessment criteria for continuous assessment are as per Table 1.

Table 1: Continuous Assessment for Industry Internship

Internship Objectives and Goals	Internship Experience Skills Gained/Enhanced	Professional Development and Growth	Internship Report	Presentation
(30 Marks)	(30 Marks)	(30 Marks)	(30 Marks)	(30 Marks)

The ESE will be jointly evaluated by an industry mentor, faculty member and department T&P coordinator (TPC). The evaluation criteria are as per Table 2.

Table 2: Evaluation Criteria of Industry Internship

Internship Objectives and Goals	Internship Experience Skills Gained/Enhanced	Professional Development and Growth	Internship Report	Presentation
(30 Marks)	(30 Marks)	(30 Marks)	(30 Marks)	(30 Marks)

Industry Internship Report:

Upon completion of the internship, students should prepare a comprehensive report that reflects their observations and learnings during the training period. Students can consult their Industrial Supervisor, Faculty Mentor, or T & P Officer for guidance on selecting special topics and problems for the report.

The internship report will be evaluated based on the following criteria:

I. Adequacy and purposeful write-up.

II. Variety and relevance of learning experiences.

III. Practical applications and connections with the fundamental theories and concepts covered in the course (semester I to VII).

B. In-house Internship:

The in-house internship provides students with research-oriented opportunities to cultivate a research mindset. It serves as an extension of the project completed in VI and VII semesters (Project Stage-I & II) or offers new objectives provided by the department or research guide.

1. The in-house internship can be pursued individually or as a group activity.
2. If extending a project from Stage II, at least one student in the group must have participated in Stage I & II.
3. If working on the topic offered by the department or in-house mentor, a group of fresh students can form a team.
4. The maximum group size is limited to four students.
5. In case of extension of project stage II, the outcomes should be in the form of product development/technology transfer along with patent and copyright / one research publication (UGC care listed journal/conference). Students can work jointly with any government funding agency or industry. In such cases, a detailed project report shall be submitted after verification by the in-house mentor and industry/funding agency mentor/authority. In case of standalone/non- sponsored activity, i.e. without any funding agency/industry collaboration, the detailed project report shall be submitted after verification by the in-house mentor.
6. If pursuing a Topic offered by the department or in-house mentor, the outcome of the in-house internship should include the publication of a journal paper, preferably in an SCI/Scopus/UGC care listed/indexed conference. The detailed project report must be submitted and verified by the in-house mentor.
7. All the designated work shall be submitted to the department in the form of a report in hard- bound as well as soft copy.
8. Evaluation Scheme:

   Continuous Assessment (A):

   - A logbook (as per Table 3) of the work done must be maintained by each group.
   - Each in-house internship activity will be reviewed twice in the semester. In the first review (as per Table 4), at least 40% work shall be completed including the topic identification / introduction/ scope of the work, literature survey, problem definition and objectives. The remaining 60% of work shall be completed in the second review

(as per Table 5) including implementations, key findings, publications & /patenting & /copyright & / product development etc.

End Semester Examination:

End semester examination (as per Table 6) will be jointly evaluated by the faculty mentor and an external examiner appointed by the HOD in consultation with the COE.

Assessment Formats:

Table 3: Log Book Format

Sr. No	Week (Start Date: End Date)	Work Done	Sign of In- house mentor	Sign of Coordinator

Table 4: First Review

Sr. No	Topic Identification & Validation	Literature Survey	Problem Definition	Objectives
	20 Marks	20 Marks	20 Marks	15 Marks

Table 5: Second Review

Sr. No	Implementation	Publications	Report	Presentation
	20 Marks	20 Marks	20 Marks	15 Marks

Table 6: End Semester Examination

Sr. No	Topic Identification & Validation	Literature Survey & Problem Definition	Objectives & Implementation/ Product Development	Presentation	Report, Publications/Patent /IPR documents
	30 Marks	30 Marks	30 Marks	30 Marks	30 Marks