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: 2023-2027

With effect from Year 2026-27

(RCP23 NEP Scheme)

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405

www.rcpit.ac.in

Semester-VII/VIII-NEP (w.e.f. Academic Year 2026-27)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	Total Credit
							Continuous Assessment (CA)				ESE			
				L	T	P	TA	TT1	TT2	Average TT1 & TT2				
							A			B	C	A+B+C		
1	PC	RCP23ECPC701	Mobile Communication System	3	--	--	25	15	15	15	60	100	3	4
		RCP23ELPC701	Mobile Communication System Laboratory	--	--	2	25	--	--	--	25	50	1	
2	PE#	RCP23ECPE711	Optical Fiber Communication	3	--	--	25	15	15	15	60	100	3	4
		RCP23ELPE711	Optical Fiber Communication Laboratory	--	--	2	25	--	--	--	25	50	1	
		RCP23ECPE712	Embedded Systems and Real-Time Firmware Design	3	--	--	25	15	15	15	60	100	3	
		RCP23ELPE712	Embedded Systems and Real-Time Firmware Design Laboratory	--	--	2	25	--	--	--	25	50	1	
		RCP23ECPE713	Computer Vision	3	--	--	25	15	15	15	60	100	3	
		RCP23ELPE713	Computer Vision Laboratory	--	--	2	25	--	--	--	25	50	1	
		RCP23ECPE714	Wireless Networks	3	--	--	25	15	15	15	60	100	3	
		RCP23ELPE714	Wireless Networks Laboratory	--	--	2	25	--	--	--	25	50	1	
3	PE#	RCP23ECPE721	Microwave System Design	3	--	--	25	15	15	15	60	100	3	4
		RCP23ELPE721	Microwave System Design Laboratory	--	--	2	25	--	--	--	25	50	1	
		RCP23ECPE722	Robotics and Industrial Automation	3	--	--	25	15	15	15	60	100	3	
		RCP23ELPE722	Robotics and Industrial Automation Laboratory	--	--	2	25	--	--	--	25	50	1	
		RCP23ECPE723	Advanced Digital Signal Processing	3	--	--	25	15	15	15	60	100	3	
		RCP23ELPE723	Advanced Digital Signal Processing Laboratory	--	--	2	25	--	--	--	25	50	1	
		RCP23ECPE724	CMOS Analog VLSI Design	3	--	--	25	15	15	15	60	100	3	
		RCP23ELPE724	CMOS Analog VLSI Design Laboratory	--	--	2	25	--	--	--	25	50	1	
4	MD	RCP23ECMD701	Natural Language Processing	2	--	--	25	15	15	15	60	100	2	3
		RCP23ELMD701	Natural Language Processing Laboratory	--	--	2	25	--	--	--	25	50	1	
5	EL	RCP23ITELX08	Research Ecosystem	--	2	--	50	--	--	--	--	50	2	2
6	EL	RCP23IPEL701	Project Stage-II	--	--	8	50	--	--	--	50	100	4	4
7	HS	RCP23ICHSX09	Disaster Management and Preparedness	2	--	--	--	--	--	--	--	--	--	Audit
8	SC	RCP23ECSC701	Generative AI and Large Language Models	1	--	--	40	--	--	--	--	40	1	1
			Total	14	2	16	340	--	--	60	390	790	22	22

Any One Elective

Prepared By	Checked By	BOS Chairman	Dean Academics	COE	Director
Dr. Bhushan V. Patil	Dr. Prashant G. Patil	Prof.Dr. Vijay S. Patil	Prof.Dr. Pramod J. Deore	Prof.S.P. Shukla	Prof.Dr. J.B. Patil

Controller of Examination
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Shirpur Dist.Dhule 4...

Dean, Academics
R. C. Patel Institute of Technology
Shirpur, Dist: Dhule (MS)

DIRECTOR
R. C. Patel Institute of Technology
Shirpur Dist Dhule (MS)

Semester- VII/VIII -NEP (w.e.f. Academic Year 2026-27)														
Sr. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	Total Credit
							Continuous Assessment (CA)				ESE			
				L	T	P	TA	TT1	TT2	Average TT1 & TT2				
							A			B	C	A+B+C		
1	PE#	RCP23ECPE811	Next Generation Networks*	3	--	--	25	15	15	15	60	100	3	3
		RCP23ECPE812	Remote Sensing*	3	--	--	25	15	15	15	60	100	3	
		RCP23ECPE813	Audio and Speech Processing*	3	--	--	25	15	15	15	60	100	3	
		RCP23ECPE814	Internet Engineering and Network Security*	3	--	--	25	15	15	15	60	100	3	
		RCP23ECPE815	Satellite Communication*	3	--	--	25	15	15	15	60	100	3	
			NPTEL / Swayam Course**	3	--	--	25	15	15	15	60	100	3	
2	EL	RCP23IPELX10	Internship (OJT) cum Project	--	--	36	200	--	--	--	200	400	18	18
3	SC	RCP23ECSC801	AI for Telecommunications	1	--	--	40	--	--	--	--	40	1	1
			Total	**4**	**--**	**36**	**265**	**--**	**--**	**15**	**260**	**540**	**22**	**22**

Any One Elective

1. *Program Elective Courses offered by institute for the students doing Internship (OJT).
2. **Program Elective Courses offered by NPTEL/SWAYAM for the students doing Internship (OJT).
   - These courses are to be studied in self-study mode using NPTEL/SWAYAM platform.
   - Students doing Internship (OJT) shall submit certificates of NPTEL examination OR they have to appear examinations conducted by institute like TT1, TT2 and ESE.
   - Students undergoing Internship (OJT) have the option to appear for both the NPTEL examination and End Semester Examination (ESE) conducted by institute for respective course. In such cases, the better of the two scores (NPTEL or ESE) shall be considered for final grading.
   - List of NPTEL courses will be declared by concerned BOS at the beginning of semester.

Prepared By	Checked By	BOS Chairman	Dean Academics	COE	Director
Dr. Bhushan V. Patil	Dr. Prashant G. Patil	Prof.Dr. Vijay S. Patil	Prof.Dr. Pramod J. Deore	Prof.S.P. Shukla	Prof.Dr. J.B. Patil

Dean, Academics
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R.C. Patel Institute of Technology
Shirpur Dist Dhule (MS)

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Mobile Communication System (RCP23ECPC701)	
Mobile Communication System Laboratory (RCP23ELPC701)	

Pre-requisite:

- Analog & Digital Communication
- Computer Networks

Course Objectives:

- To learn various hardware network components.
- To understand network reference models and processes involved in data communication.
- To analyse the protocols working in different layers.
- To design and configure a network for an organization.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Compare OSI layered architecture with TCP/IP protocol suite and differentiate functions of each layer.	L4	Analyze
CO2	Define characteristics of physical media and differentiate among multiplexing techniques.	L2	Understand
CO3	Explain the responsibilities of the data link layer and explain the datalink layer protocols.	L2	Understand
CO4	Design network and subnetwork using commands and carry out investigations and troubleshooting.	L3	Apply
CO5	Distinguish transport layer protocols based on application.	L4	Analyze

Mobile Communication System (RCP23ECPC701)

COURSE CONTENTS

Unit-I **Mobile Radio Propagation** **6 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 Rician distributions.

Unit-II **Fundamentals of Mobile Communication** **6 Hrs.**

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 conventional multiple access techniques: Frequency division multiple access (FDMA), Time division multiple access (TDMA), OFDM

Unit-III **Transition from 2G Networks to 3G UMTS Technology** **6 Hrs.**

UMTS network architecture, Protocol Structure, Channel Structure, Frame slots and symbols, modulation, coding, multiple antenna techniques, WCDMA, Modulation, Handoff and Power Control.

Unit-IV **4G Network** **8 Hrs.**

LTE network: Architecture, Physical layer, Frames, slots, and symbols, modulation, coding, MIMO, LTE Radio Access, Radio-Interface Architecture, Physical Transmission Resources, Downlink and Uplink Physical-Layer Processing, Scheduling and Rate Adaptation.

Unit-V **Advanced Wireless Communication Techniques** **8 Hrs.**

Cognitive radio: Architecture, spectrum sensing

Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals.

SDR: Architecture, limitations, advantages, disadvantages.

Unit-VI **Road map towards 5G and beyond** **8 Hrs.**

5G Network: Requirements and challenges, 5G NR Architecture, Standalone (SA) and Non-Standalone (NSA), Massive MIMO, Numerology and Subcarrier Spacing, Beamforming, mmWave Communication, Network Slicing, Edge Computing, Ultra-Reliable Low Latency Communication (URLLC), Enhanced Mobile Broadband (eMBB), Massive Machine Type Communication (mMTC)

Introduction to 6G and Future Wireless Trends

Mobile Communication System Laboratory (RCP23ELPC701)

List of Laboratory Experiments: (Minimum 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 system.
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
11. Study of frequency reuse using Matlab/Scilab
12. To study performance evaluation of handovers for absolute signal strength measurement
13. Modulation Techniques
14. MIMO OFDM

Text Books

1. Vijay K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Series in Networking, Elsevier, 2010.
2. Rappaport, T.S., “Wireless Communications”, Pearson Education, 2nd Edition, 2010
3. T. L. Singal, “Wireless Communications”, McGraw Hill Education, 2012.
4. Andreas F. Molisch, “Wireless Communications: From Fundamentals to Beyond 5G”, Wiley-IEEE Press, 3rd Edition, 2022.

Reference Books

1. Upena Dalal, “Wireless and Mobile Communications”, Oxford University Press, 2016.
2. Vijay K. Garg, “Wireless Communications and Networking”, Morgan Kaufmann Series in Networking, Elsevier, 2007.
3. Young Kyun Kim and Ramjee Prasad, “4 G Roadmap and Emerging Communication Technologies”, Artech house,3rd Edition, 2006.
4. Raj Pandya, “Mobile and Personal Communications Systems And Services”, Prentice Hall,3rd Edition, 2000.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Optical Fiber Communication (RCP23ECPE711)	
Optical Fiber Communication Laboratory (RCP23ELPE711)	

Pre-requisite:

- Applied Physics
- Wave Theory & Radio Frequency Design
- Analog & Digital Communication

Course Objectives:

- To understand and analyze Optical fiber structures wave guide, fabrication and signal degradation in fiber.
- To understand and analyze 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	Describe the propagation of light in optical fibers for the ray theory and electromagnetic mode theory.	L2	Understand
CO2	Analyze transmission characteristics (attenuation /dispersion/Nonlinearity) of an optical fiber using different techniques.	L4	Analyze
CO3	Compare and contrast working principle of optical sources, detectors and components.	L2	Understand
CO4	Design optimal optical links by using Link budget and rise time budget and understand basic concepts of optical networks.	L6	Create

Optical Fiber Communication (RCP23ECPE711)

COURSE CONTENTS

Unit-I **Optical Fiber Fundamentals** **8 Hrs.**

Motivations for light wave communications, General Optical system block diagram, advantages, disadvantages and applications of optical fiber communication, Loss and bandwidth window optical fiber waveguides, Types and classification of optical fibers.

Unit-II **Transmission Characteristics of Optical Fiber and Optical Measurements** **12 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.

Optical Measurements Introduction to the Optical measurements, Fiber attenuation measurements, Fiber dispersion measurements, Fiber refractive index profile measurements, Fiber cut-off wavelength measurements, Fiber numerical aperture measurements, Fiber diameter measurements, Mode-field diameter for single-mode fiber, Reflectance and optical return loss, Field measurements

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

Working principle and characteristics of sources (LED, LASER), Tunable 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), Resonant cavity enhancement (RCE) Photo Detector, receiver structure, bit error rate of optical receivers and receiver performance. Optical instrumentation, Integrated optics, Fiber optic sensors

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** **8 Hrs.**

Optics 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, coherent optical space communication, Drawback and problems of realization, system description and design, Telecommunications technology

Optical Fiber Communication Laboratory (RCP23ELPE711)

List of Laboratory Experiments: (Minimum Eight)

1. Calculation of Numerical aperture.
2. Analysis of various Transmission Characteristics of Optical Fiber cable.
3. Performance analysis of Single mode fiber.
4. Performance analysis of Graded Index fiber and Multimode Fiber.
5. Study of Optical Analog communication link.
6. Study of Optical Digital communication link.
7. Performance Analysis of Optical Link with Different Sources and detectors.
8. Power budget and Rise Time Budget Analysis for Optical Link (Eye Diagram)
9. Performance Analysis of Optical Amplifier.
10. Calculation of link Loss for given link with nonlinearities.
11. Case Study: Power budget and Rise Time Budget Analysis for Optical Link.
12. Case Study: FSO Link and its Analysis.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. John M. Senior, “Optical Fiber Communications”, 3rd Edition, 1998, Pearson Education.
2. Gerd Keiser, “Optical Fiber Communication”, 4th Edition, 2003, Mc Graw Hill.
3. JH Franz, VK Jain, “Optical Communications Components and Systems”, 2nd Edition, 2013.

Reference Books

1. Harold Kolimbiris, “Fiber optics communications”,2007, Pearson Education
2. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, 3rd, Edition, 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 Edition, Pearson Education.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Embedded Systems and Real-Time Firmware Design (RCP23ECPE712)	
Embedded Systems and Real-Time Firmware Design Laboratory (RCP23ELPE712)	

Pre-requisite:

- Digital System Design
- Microcontroller and Applications

Course Objectives:

- To develop the ability to design, implement and debug modern real-time embedded systems using ARM Cortex-M based platforms, embedded firmware methodologies, peripheral interfacing techniques and RTOS concepts for practical engineering applications while exposing learners to emerging trends in connected and intelligent embedded systems.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the architecture, design methodology and operational characteristics of modern embedded systems and ARM Cortex-M based microcontrollers.	L2	Understand
CO2	Demonstrate the ability to analyze ARM Cortex-M3 architecture and develop embedded firmware utilizing memory organization, interrupt handling, low-power operation and system reliability features in real-time embedded systems.	L4	Analyze
CO3	Implement embedded communication and sensor interfacing solutions using standard protocols such as UART, SPI and I2C.	L3	Apply
CO4	Analyse and design multitasking real-time embedded applications using RTOS concepts including scheduling, synchronization and inter-task communication.	L6	Create
CO5	Analyse, debug and evaluate embedded firmware systems while demonstrating awareness of modern embedded engineering practices, low-power systems and emerging embedded technologies.	L5	Evaluate

Embedded Systems and Real-Time Firmware Design ((RCP23ECPE712))

COURSE CONTENTS

Unit-I Modern Embedded Systems Overview 6 Hrs.

Evolution of embedded systems, Characteristics and classification of embedded systems, MCU vs MPU vs SoC, Applications of embedded systems in – automotive, industrial automation, medical electronics, IoT, robotics, wearables, consumer electronics. Real-time constraints and design metrics – Power, cost, reliability and latency trade-offs, Embedded system design lifecycle, Hardware-software co-design; Firmware architecture concepts, Bare-metal vs RTOS based system.

Unit-II ARM Cortex-M Architecture and Embedded Firmware 12 Hrs.

Comparison of CISC & RISC architectures, overview of ARM family, ARM Cortex-M3 architecture, Programmer's model – Operation Modes and States, Registers, special registers; Application Program Status Register – Integer status flags, Q status flag, GE bits. Memory system – Features and memory map, Exceptions and Interrupts, Nested vectored interrupt controller (NVIC); Low power design, Cortex – M low power features, Developing low power applications. Polling versus interrupts, Interrupt response time and interrupt service routines, Watchdog Timer and Brownout Detection.

Unit-III Embedded Communication 8 Hrs.

Communication Protocols – UART, SPI, I2C, CAN, USB. Wireless communication protocol – Wi-Fi , Bluetooth, Bluetooth low energy, Zigbee, LoRa WAN; Industrial Ethernet Protocol – Ether CAT; MQTT concepts.

Unit-IV Real-Time Operating Systems and Firmware Architecture 12 Hrs.

Introduction to real-time systems, Hard and soft real-time systems. Need for RTOS, RTOS architecture and kernel concepts, Processes, tasks and threads, Task states and context switching. Scheduling Techniques – Round robin scheduling, Cooperative scheduling, Preemptive scheduling, Rate Monotonic Scheduling, Earliest Deadline First; Synchronization and Communication – Semaphores, Mutex, Queues, Event groups, Software timers, Mailboxes. RTOS Issues – Deadlock, Starvation, Priority inversion, Determinism. RTOS Platforms – Free RTOS overview.

Unit-V Modern Embedded Engineering Practices and Emerging Trend 4 Hrs.

Embedded debugging methodologies – printf, & JTAG; Logic analyzer and oscilloscope usage, Embedded testing concepts, Bootloader and OTA update concept, Low-power firmware design basics.

Embedded Systems and Real-Time Firmware Design Laboratory

(RCP23ELPE712)

List of Laboratory Experiments: (Minimum Eight)

1. Study of STM32 Nucleo board architecture and STM32CubeIDE environment.
2. GPIO interfacing and push button interrupt programming.
3. Timer programming and PWM generation.
4. ADC interfacing for analog sensor acquisition.
5. UART communication and serial debugging.
6. SPI or I2C interfacing with external peripherals.
7. Interrupt driven data acquisition system.
8. Circular buffer implementation for serial communication.
9. Watchdog timer implementation.
10. DMA based peripheral data transfer.
11. Task creation and scheduling using FreeRTOS.
12. Inter-task communication using queues.
13. Semaphore and mutex implementation.
14. Producer-consumer implementation using RTOS.
15. Multi-task sensor monitoring system using FreeRTOS.
16. Low-power mode implementation and analysis.
17. CAN/BLE communication demonstration.
18. State-machine based firmware implementation.
19. Embedded logging and debugging exercise.
20. Mini-project implementation based on integrated real-time embedded application.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. Shibu K. V., Introduction to Embedded Systems, 2nd ed. New Delhi, India: McGraw Hill Education, 2017.
2. K. V. K. K. Prasad, Embedded/Real-Time Systems: Concepts, Design and Programming, New Delhi, India: DreamTech Press, 2005.
3. J. Yiu, The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, 3rd ed. Oxford, U.K.: Newnes/Elsevier, 2014.

Reference Books

1. S. R. Iyer and P. Gupta, Embedded Real-Time Systems Programming, New Delhi, India: Tata McGraw-Hill Education, 2004.
2. D. E. Simon, An Embedded Software Primer, Boston, MA, USA: Pearson Education, 1999.
3. R. Kamal, Embedded Systems: Architecture, Programming and Design, 3rd ed. New Delhi, India: McGraw Hill Education, 2017.
4. R. Barry, Mastering the Free RTOS Real Time Kernel: A Hands-On Tutorial Guide, Real Time Engineers Ltd., 2016.
5. E. White, Making Embedded Systems: Design Patterns for Great Software, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2024.

Web Resources:

1. https://www.youtube.com/watch?v=dnfuNT1dPiM – Robert Feranec guides a step-by-step tutorial using STM32CubeIDE to program a Nucleo-F401RE board.
2. https://wiki.st.com/stm32mcu/wiki/STM32StepByStep:Getting_started_with_STM32_:_STM32_step_by_step – Getting started with STM32: STM32 step-by-step

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Computer Vision (RCP23ECPE713)	
Computer Vision Laboratory (RCP23ELPE713)	

Pre-requisite:

- Python Programming Laboratory
- Digital Signal Processing
- Image Processing

Course Objectives:

- To understand the fundamentals of digital image processing, image formation, camera geometry, and geometric transformations used in computer vision systems.
- To develop knowledge of feature detection, feature extraction, descriptors, and feature matching techniques for image analysis and recognition.
- To analyze and implement deep learning techniques for image classification, object detection, segmentation, and visual understanding tasks.
- To study motion analysis methods including optical flow, motion detection, object tracking, and structure from motion for video-based computer vision applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply concepts of image formation, camera models, image enhancement, filtering, and geometric transformations for pre-processing and analysis of digital images.	L3	Apply
CO2	Analyze and implement edge, corner, interest point detection, and feature extraction and matching techniques for object representation and recognition tasks.	L4	Analyze
CO3	Develop deep learning-based computer vision solutions using CNN architectures, transfer learning, object detection, and segmentation models.	L6	Create
CO4	Evaluate motion analysis and tracking techniques including optical flow, background subtraction, object tracking, and structure-from-motion for dynamic scene understanding.	L5	Evaluate

Computer Vision (RCP23ECPE713)

COURSE CONTENTS

Unit-I **Image Formation and Camera Geometry** **8 Hrs.**

Review of digital image fundamentals: Fourier Transform, Convolution and Filtering, Image Enhancement, Histogram Processing

Pinhole camera model. Coordinate systems: World coordinates, Camera coordinates, Image coordinates. Perspective projection, Orthographic projection, Camera modelling and calibration concepts

Geometric transformations: Translation, Rotation, Scaling, Affine transformation, Projective transformation, Perspective transformation, Stereo vision basics, Epipolar geometry (introductory level)

Unit-II **Edge, Corner and Interest Point Detection** **8 Hrs.**

Gradient operators: Roberts, Prewitt, Sobel, Laplacian Canny edge detector, Scale-space representation, Laplacian of Gaussian (LOG) and Difference of Gaussian (DoG), Corner detection: Harris corner detector, Hessian corner detection

Hough transform: Line detection, Circle detection Interest point detection concepts, non-maximum suppression.

Unit-III **Feature Extraction, descriptors and matching** **10 Hrs.**

Feature Extraction: Local vs global features, Texture descriptors, Histogram of oriented gradients (HoG), GLOH

Feature Descriptors: Scale invariant feature transform (SIFT), Speeded-up robust features (SURF), Oriented FAST and Rotated BRIEF (ORB).

Feature matching: Brute-force matching, Fast Library for Approximate Nearest Neighbors (FLANN) matcher, Random Sample Consensus (RANSAC) algorithm

Unit-IV **Deep Learning for Computer Vision** **10 Hrs.**

Introduction to Convolutional Neural Networks (CNNs), image classification models (VGG, ResNet, MobileNet) through transfer learning, Attention Mechanism in Computer Vision.

Object Detection using deep learning: One-stage detectors- YOLO (You Only Look Once), SSD (Single Shot MultiBox Detector), Two-Stage Detectors - R-CNN family (Regions with CNN features) Object Segmentation with deep learning: UNet and Mask R-CNN

Unit-V **Motion Analysis** **6 Hrs.**

Motion models, Optical flow: Lucas-Kanade method, Horn-Schunck method, Shape from optical flow, Background subtraction, Motion detection in videos, Object tracking: Kalman filter basics, Mean-shift tracking, Structure from Motion (SfM)

Computer Vision Laboratory (RCP23ELPE713)

List of Laboratory Experiments: (Minimum Eight)

1. Basic Image Operations and Image Representation.
2. Camera Geometry and Geometric Transformations
3. Edge Detection Techniques
4. Scale Space and Corner Detection: Harris and Hessian, Blob detection
5. Hough Transform for Shape Detection
6. Feature Extraction using HoG and Texture Descriptors
7. Feature Descriptors and Feature Matching: SIFT, SURF, or ORB.
8. CNN-based Image Classification using Transfer Learning
9. Object Detection using Deep Learning: YOLO or SSD
10. Implement semantic segmentation using UNet or Mask R-CNN.
11. Optical Flow and Motion Detection.
12. Object Tracking and Structure from Motion
13. Use stereo image pairs to estimate depth using disparity maps.
14. Apply object tracking algorithms such as Mean-shift, Camshift, or KLT tracker.
15. Implement HOG with SVM for any classification problem

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2nd Edition, 2022.
2. David A. Forsyth and Jean Ponce, “Computer Vision – A Modern Approach”, PHI Learning, 2nd Edition, 2009.
3. Richard Hartley, Andrew Zisserman, "Multiple View Geometry in Computer Vision," Cambridge University Press, Second Edition, 2003

Reference Books

1. Adrian Rosebrock, “Deep Learning for Computer Vision with Python”, 1st Edition, 2017.
2. Jan Erik Solem, “Programming Computer Vision with Python”, O’Reilly Media, First Edition, 2012
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, First Edition, 2016.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Wireless Networks (RCP23ECPE714)	
Wireless Networks Laboratory (RCP23ELPE714)	

Pre-requisite:

- Analog & Digital Communication
- Computer Networks

Course Objectives:

- To understand concept of wireless transmission and spectrum requirement.
- To understand the concepts of WPAN.
- To understand the concepts of WLAN.
- To understand the concepts of WSN and range of category 1 and category 2 applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the fundamentals, standards, architectures, and spectrum requirements of various wireless communication networks.	L4	Analyze
CO2	Evaluate the operation, protocol stack, topologies, security features, and applications of WPAN technologies.	L5	Evaluate
CO3	Analyze IEEE 802.11 WLAN and IEEE 802.16 WiMAX technologies.	L4	Analyze
CO4	Design Wireless Sensor Network (WSN) and Wireless Body Area Network (WBAN) solutions for WSN applications using appropriate middleware concepts.	L6	Create

Wireless Networks (RCP23ECPE714)

COURSE CONTENTS

Unit-I **Basics of Wireless Networks** **2 Hrs.**

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

Unit-II **Wireless Personal Area Networks** **12 Hrs.**

Bluetooth (802.15.1): Radio Specifications, Protocol Stack, Link Types, Security, Topologies, Connection establishment, Applications. Zigbee (802.15.4): Radio Specifications, Components, Topologies, Protocol Stack, Applications.

RFID: Radio Specifications, Architecture & Types, Applications. Near Field Communication

UWB: Introduction to UWB and its characteristics, Spectrum and pulse-based communication, IEEE 802.15.3a standard for high-speed WPAN, IEEE 802.15.4a standard for low-power communication and localization IEEE 802.15.4z standard for secure and accurate ranging UWB ranging and localization concepts Applications of UWB in indoor positioning, IoT, asset tracking, and smart devices, Advantages and limitations of UWB

Unit-III **Wireless Local Area Network & Wireless Metropolitan Area Networks** **10 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 Introduction to WiMAX, WiMAX architecture and working principle, IEEE 802.16 standards and evolution, Advantages and limitations of WiMAX. 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, Applications of wireless sensor network: examples of category 1& 2

Unit-V **Wireless Body Area Network (WBAN)** **5 Hrs.**

Introduction to WBAN and its characteristics, Network Architecture, Network Components, Applications of WBAN in healthcare, fitness, and remote monitoring, Security and power management issues in WBAN, Advantages

and limitations of WBAN.

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

Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware.

Wireless Networks Laboratory (RCP23ELPE714)

List of Laboratory Experiments: (Minimum Eight)

1. Installation and study of network simulation tool such as NS2/ NS3.
2. Creating Wireless nodes for WLAN/ WSN
3. Creating various topologies for wireless networks using simulation tool like NS2/NS3.
4. Creating sensor nodes with reference to their communication range using NS2/NS3.
5. Analysis of Wi-Fi network.
6. Data transfer using Bluetooth.
7. Data transfer using Zigbee.
8. Data transfer using RFID.
9. Case study on WSN Application
10. Case Study on campus Wi-Fi installation

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. Vijay K. Garg, "Wireless Communication and Networking", Morgan, Kaufmann Series in Networking, Elsevier, First edition, 2007.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, First edition, 2007, John Wiley &Sons.

Reference Books

1. Upena Dalal, "Wireless and Mobile Communications", First edition, 2015, Oxford University Press.
2. Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, 2010, Pearson Publication.
3. Sunil Kumar, S. Manvi, and Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocol", 2nd Edition, 2010, Wiley Publication.
4. Raj Kamal, "Internet of Things Architecture & Design Principles", 4th Edition, 2017, McGraw Hill.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Microwave System Design (RCP23ECPE721)	
Microwave System Design Laboratory (RCP23ELPE721)	

Pre-requisite:

- Electronics and Devices and Circuits
- Wave Theory & Radio Frequency Design
- Analog & Digital Communication
- Radiating Systems

Course Objectives:

- To understand the fundamentals of microwave engineering and its applications.
- Analyze of microwave components and design of microwave amplifier.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain microwave frequency bands, propagation characteristics, microwave communication systems, and measurement techniques used in microwave engineering.	L2	Understand
CO2	Analyze microwave characteristics of microwave generation and amplification using active and passive devices.	L4	Analyze
CO3	Apply transmission line theory and waveguide concepts for the analysis and design of microwave transmission structures including stripline and microstrip circuits.	L3	Apply
CO4	Design of small and large signal amplifier with maximum and unilateral gain amplifier design.	L6	Create
CO5	Explain various microwave applications and effects on electromagnetic signals.	L2	Understand

Microwave System Design (RCP23ECPE721)

COURSE CONTENTS

Unit-I Microwave Communication Systems and Measurements 4 Hrs.

Introduction to Microwave Communication Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves.

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

Unit-II Waveguide and Planar Transmission Lines 10 Hrs.

Parallel plate waveguide, rectangular waveguide, circular waveguide, Microstrip line and Strip line: Analysis and Design, Even-odd mode analysis.

Unit-III Microwave Generation and Amplification 6 Hrs.

Two Cavity Klystron and Reflex Klystron, Helix Travelling Wave Tube and Backward Wave Oscillator, Cylindrical Magnetron.

Unit-IV Microwave Devices and Components 8 Hrs.

Tees, Directional couplers, Phase shifters, Terminations, Attenuators and Ferrite devices such as Gyrator, Isolator, Circulator.

Diodes: Varactor diode, PIN diode, Tunnel, Gunn, IMPATT, Application of Tunnel, Gunn and IMPATT diode as a Microwave Oscillator, (construction, working, equivalent circuit and performance characteristics).

Unit-V Microwave Amplifier Design 10 Hrs.

Two-Port Power Gains, Stability Circles, Single-Stage Amplifier Design: Design for Maximum Gain (Conjugate Matching), Constant-Gain Circles and Design for Specified Gain, Low-Noise Amplifier Design, Large-Signal Characterization of Transistors, Design of Class A Power Amplifiers.

Unit-VI Microwave Applications and Hazards 4 Hrs.

Medical (Microwave Imagining, Microwave Diathermy) and Civil applications (Microwave heating, Instrumentation Landing Systems) Microwave hazards, Biological Effects and Safety.

Microwave System Design Laboratory (RCP23ELPE721)

List of Laboratory Experiments: (Minimum 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. Amplifier design using smith chart
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.
10. Mode Pattern Analysis for Rectangle Waveguide
11. CST based Simulation for Microwave Components

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. Samuel Liao, “Microwave Devices and Circuits”, Prentice Hall.
2. M. Kulkarni, “Microwave and Radar Engineering,” 3rd Edition, Umesh Publication.
3. D. M. Pozar, “Microwave Engineering” 4th Edition, Wiley Publications, 2012.

Reference Books

1. Annapurna Das, Sisir K. Das, “Microwave engineering”, TMH, 5th Edition, 2021.
2. Peter A. Rizzi, “Microwave Engineering: Passive Circuits” Prentice Hall, 2nd Edition, 1998.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Robotics and Industrial Automation (RCP23ECPE722)	
Robotics and Industrial Automation Laboratory (RCP23ELPE722)	

Pre-requisite:

- Mathematics for Telecommunication Engineering
- Integrated Circuits
- Control System

Course Objectives:

- To understand the anatomy of Robots and kinematics for industrial applications.
- To cover various path planning methodologies for robotic navigation and task execution.
- To understand various types of controllers used in process and their tuning for different applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain basic concepts of robotics.	L2	Understand
CO2	Explain the principle of direct and inverse kinematics in robotic operation.	L2	Understand
CO3	Analyze the controller parameters for discrete or continuous type.	L4	Analyze
CO4	Design the process controller (electronic) for a given process or application.	L6	Create

Robotics and Industrial Automation (RCP23ECPE722)

COURSE CONTENTS

Unit-I **Fundamentals of Robotics** **4 Hrs.**

Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Applications.

Unit-II **Kinematics of Robots** **8 Hrs.**

Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation.

Denavit - Hartenberg representation of forward kinematics, Forward and inverse kinematic solutions of SCARA robot.

Unit-III **Trajectory planning** **4 Hrs.**

Basics of Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories.

Unit-IV **Analog & digital signal conditioning and Instrumentation Circuits** **10 Hrs.**

Signal level & bias change, linearization, conversion, filtering & impedance matching, concept of loading, comparators & converters.

Design of operational amplifier-based circuits in instrumentation – analysis of voltage divider circuits, bridge circuits, inverting & non-inverting amplifier, instrumentation amplifier, V to I & I to V converter, integrator, differentiator & linearization.

Transmitters – Introduction to telemetry & its basic block diagram, 2 wire, 3 wire & 4 wire transmitters, 4 mA to 20 mA current transmitter, current to

pressure (I to P) & pressure to current (P to I) converters.

Unit-V **Controllers Discontinuous & Continuous and Tuning** **8 Hrs.**

Two position discontinuous control mode. Continuous control mode – single mode (P, I & D) & composite mode (PD, PI & PID), selection criterion of controller for a process mode

Tuning of PID controller – open loop transient response method, Ziegler – Nichols tuning method, frequency response method.

Unit-VI **Discrete state process controller** **8 Hrs.**

Discrete state process variables, specifications & event sequence description Relay controller, ladder diagram logic, ladder diagram elements & ladder diagram programming examples PLC – relay sequencers, programmable logic controller design, PLC operation, programming the PLC. HMI and SCADA.

Robotics and Industrial Automation Laboratory (RCP23ELPE722)

List of Laboratory Experiments: (Minimum Eight)

1. Forward kinematics
2. Inverse kinematic
3. Dynamic analysis
4. Joint-space trajectory
5. Cartesian-space trajectory
6. Design of stepper motor interface & controller
7. Design of instrumentation amplifier for variable voltage gain
8. Design of signal conditioning circuits for LDR / thermistor / RTD / strain gauge
9. Tuning of P+I+D controller using MATLAB / Simulink
10. Implementation of PLC ladder diagram for given application

Seminars on Actuators – Electrical, Pneumatic and Hydraulic on the following content:

S.1 Electrical actuators: relays, solenoids & electrical motors (DC, AC & stepper motor)

S.2 Pneumatic actuators: basic pneumatic system, pneumatic compressors (piston, vane, screw) flapper nozzle, single & double acting cylinder, rotary actuator, filter-regulator-lubricator (FRL)

S.3 Hydraulic actuator: hydraulic pumps, control valves types (globe, ball, needle, butterfly, gate, diaphragm & pinch), cavitation & flashing with their remedies, pressure drop across valve & leakage, valve noise, flow characteristics on load changes, control valves parameters, control valves sizing, valve calibration, digital control valves, selecting control valves & applications

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. Robert Shilling, “Fundamentals of Robotics - Analysis and control”, Prentice Hall of India, 2009.
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., 2nd Edition, 2011.
3. Curtis D. Johnson, “Process Control Instrumentation Technology”, 7th Edition, PHI

Reference Books

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009.
2. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control”, Wiley

India Pvt. Ltd., 2006.

3. S. K. Singh, “Industrial Instrumentation & Control”, 3rd Edition, McGraw Hill.
4. B.C. Nakra & K. K. Chaudhary, “Instrumentation Measurement & Analysis”, 3rd Edition, McGraw Hill.
5. Andrew Parr, “Pneumatics & Hydraulics”, 2nd Edition, Jaico Publishing Co.
6. G. Liptak, “Handbook of Process Control & Instrumentation”, 4th Edition, CRC Press

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Advanced Digital Signal Processing (RCP23ECPE723)	
Advanced Digital Signal Processing Laboratory (RCP23ELPE723)	

Pre-requisite:

- Digital Signal Processing

Course Objectives:

- To introduce the fundamentals of multirate digital signal processing and sampling rate conversion techniques used in modern signal processing systems.
- To develop understanding of adaptive systems and adaptive filtering algorithms for solving real-time signal processing problems.
- To familiarize students with linear prediction methods, optimum linear filters, and lattice filter structures for signal modeling and estimation.
- To impart knowledge of wavelet transforms and multiresolution analysis for advanced applications such as denoising, compression, and time-frequency analysis.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the concepts of multirate digital signal processing including decimation, interpolation, and sampling rate conversion techniques used in speech and signal processing applications.	L2	Understand
CO2	Analyze adaptive systems and implement adaptive filtering algorithms such as LMS and RLS for applications including system identification, channel equalization, echo cancellation, and noise cancellation.	L4	Analyze
CO3	Apply linear prediction and optimum linear filtering techniques for signal modeling, prediction, and filter realization using lattice and Wiener filter structures.	L3	Apply
CO4	Apply wavelet transform techniques and multiresolution analysis for signal denoising, compression, speckle removal, and time-frequency analysis applications.	L3	Apply

Advanced Digital Signal Processing (RCP23ECPE723)

COURSE CONTENTS

Unit-I **Multirate DSP** **8 Hrs.**

Introduction and concept of Multirate Processing, Block Diagram of Decimator and Interpolator, Decimation and Interpolation by Integer Numbers, Spectra after decimation and Interpolation, Sampling Rate conversion by a Rational Factor I/D.

Application: Subband coding of Speech Signals.

Unit-II **Introduction to Adaptive systems** **6 Hrs.**

Introduction, Characteristics, Examples of Adaptive systems, Adaptive linear combiner-Description, Weight vectors, desired response and error, performance function, Gradient and minimum mean square error, Decorrelation of errors and Input Components.

Unit-III **Adaptive Algorithms and Applications** **8 Hrs.**

Adaptive Direct Form FIR Filters based on steepest descent method, Widrow Hoff LMS Adaptive algorithm, RLS algorithms.

Applications: System Identification, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation.

Unit-IV **Linear Prediction and Optimum Linear Filters** **12 Hrs.**

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-V **Wavelet Theory** **8 Hrs.**

Fourier Transform and its Limitations, Short Time Fourier Transform, Introduction to time frequency analysis, Continuous Wavelet Transform, Discrete Time Wavelet Transform, Multi-resolution analysis, Haar Wavelet, Daubechies Wavelet, Filter bank theory.

Application of wavelet theory to signal denoising, speckle removal, and signal compression.

Advanced Digital Signal Processing Laboratory (RCP23ELPE723)

List of Laboratory Experiments: (Minimum Eight)

1. To perform up sampling & down sampling by integer factors.
2. Convert a signal's sampling rate by a non-integer ratio (e.g.,3/2).
3. Two-Channel Subband Coding of a Speech/Audio Signal
4. To perform Adaptive channel equalization,
5. To perform Adaptive echo cancellation
6. Unknown Channel Identification using LMS Algorithm
7. To Perform Noise Cancellation Using LMS Algorithm
8. Denoising a signal using Wavelet Transform
9. STFT vs. FT for Non-Stationary Signals (Speech Signals)
10. Speckle removal by Wavelet Transform
11. Signal compression by Wavelet Transform
12. Noise removal from ECG signal Using Digital Filter

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing”, PHI, 2014.
2. Bernard Widrow and Samuel D.Strearns, “Adaptive Signal Processing”, Pearson Edu Asia 2002.
3. Raghuveer. M. Rao and Ajit S.Bopardikar, “Wavelet Transforms -Introduction to theory and applications, Pearson Education, Asia, 2000.

Reference Books

1. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing- A Practical
2. Approach,” Pearson Education, 2nd Edition, 2002
3. Simon Haykin, “Adaptive Filter Theory,” Pearson Education, 5th Edition, 2014.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
CMOS Analog VLSI Design (RCP23ECPE724)	
CMOS Analog VLSI Design Laboratory (RCP23ELPE724)	

Pre-requisite:

- Electronics Devices & Circuits
- Integrated Circuits
- Digital VLSI Design

Course Objectives:

- To highlight the circuit design issues in the context of Analog VLSI technology
- To provide the understanding of different design styles.
- To provide an exposure to drawing layout of circuits.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe MOSFET operation and analyze small signal MOS models	L2	Understand
CO2	Design single stage amplifier based on MOSFET.	L3	Apply
CO3	Design differential amplifier based on MOSFET.	L3	Apply
CO4	Design the MOSFET-based operational amplifier.	L3	Apply
CO5	Describe the techniques of layout for analog circuits.	L2	Understand

CMOS Analog VLSI Design (RCP23ECPE724)

COURSE CONTENTS

Unit-I **CMOS Analog building blocks** **10 Hrs.**

MOS Models: Necessity of CMOS Analog Design, Review of Characteristics of MOS Device, MOS Small Signal Model, MOS SPICE Models.

Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors and Active Current Mirrors.

Band Gap References: General Considerations, Supply-Independent Biasing, Temperature-Independent References, PTAT Current Generation and Constant-Gm Biasing.

Unit-II **Single Stage Amplifiers Configurations** **12 Hrs.**

Basic concepts, Common-Source Stage with Resistive Load, CS Stage with Diode-Connected Load, CS Stage with Current-Source Load, CS Stage with Active Load, CS Stage with Triode Load, CS Stage with Source Degeneration, Common-Source amplifier using Source follower, Common-Gate stage, Cascade stage.

Frequency Response and Noise: General Considerations, Common-Source stage, Source followers, Common-Gate stage, Cascode stage and Noise in Single Stage Amplifier.

Unit-III **Differential Amplifiers** **8 Hrs.**

Configurations: Resistive load differential amplifier, Single-Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Pair with MOS Loads.

Frequency response and noise in differential Amplifiers: Differential pair with Passive Loads, Differential Pair with Active Loads.

Unit-IV **MOS Operational Amplifiers** **8 Hrs.**

Op-amp Design: General Considerations, Performance parameters, One-stage op-amps, Two-stage op-amps, Gain Boosting, Common-Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection, Noise in op-amps.

Unit-V **Analog Layout and other concepts** **4 Hrs.**

Analog Layout Techniques: Antenna Effect, Resistor Matching, Capacitor Matching, Active Device Design, Current Mirror Matching, Floor Planning, Shielding and Guard Rings.

CMOS Analog VLSI Design Laboratory (RCP23ELPE724)

List of Laboratory Experiments: (Minimum Eight)

1. To study trans-conductance plots of MOSFET device (voltage bias, current bias and technology bias).
2. To design basic amplifier using MOSFETs
3. To design cascode amplifier
4. To design basic current sink
5. To design current sink by using negative feedback resistor
6. To design cascode current sink.
7. To design of positive feedback boot strap current sink
8. To design of regulated cascode current sink
9. To design of simple current mirror
10. To design Wilson current mirror

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. B. Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2nd Edition, 2017.
2. R. Jacob Baker, Harry W. Li, David E. Boyce, “CMOS Circuit Design, Layout, and Stimulation”, Wiley, 3rd Edition, 2010.
3. P. E. Allen and D. R. Holberg, “CMOS Analog Circuit Design”, Oxford University Press, 3rd Edition, 2012.

Reference Books / online Courses

1. Mohammed Ismail and Terri Faiz, “*Analog VLSI Signal and Information Process”*, McGraw-Hill Book company,1994.
2. John P. Uyemura, "*CMOS Logic Circuit Design* ", Springer US, 2001.
3. Gray, Meyer, Lewis, Hurst, “*Analysis and design of Analog Integrated Circuits*”, Willey, 6th Edition, 2024.
4. nptel.ac.in/courses/108104193 (Prof. Imon Mondal, IITK)
5. nptel.ac.in/courses/117101105 (Prof. A. N. Chandorkar, IITB)

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Natural Language Processing (RCP23ECMD701)	
Natural Language Processing Laboratory (RCP23ELMD701)	

Pre-requisite:

- Machine Learning & Applications

Course Objectives:

- Understand the fundamental concepts, evolution, and architecture of Natural Language Processing systems.
- Apply text pre-processing and syntactic analysis techniques for processing natural language data.
- Analyze semantic and discourse level structures to interpret meaning and context in natural language.
- Evaluate and apply NLP techniques for solving real-world problems and emerging applications in IoT, Cybersecurity, and Blockchain.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the concepts, evolution, architecture, and challenges of Natural Language Processing systems.	L2	Understand
CO2	Apply text processing techniques to pre-process textual data.	L3	Apply
CO3	Analyze syntactic structures and sequence models for language modeling tasks.	L4	Analyze
CO4	Evaluate semantic analysis techniques for interpreting meaning in text.	L5	Evaluate
CO5	Analyze Pragmatic and discourse structures and coreference resolution techniques in Natural Language Processing.	L4	Analyze

Natural Language Processing (RCP23ECMD701)

COURSE CONTENTS

Unit-I Introduction to Natural Language Processing (NLP) 04 Hrs.

Definition and scope of NLP, Evolution of NLP (Rule-based → Statistical → Neural → LLMs), Traditional NLP vs LLM-based systems, Architecture / pipeline of NLP system, Levels of language processing, Ambiguity, challenges and limitations of NLP. Applications of NLP in Emerging Technologies.

Unit-II Text Processing and Word Level Analysis 4 Hrs.

Words and tokens, Word types and word instances, Corpora and vocabulary. Regular expressions for text processing, Minimum edit distance (for spelling correction), N-grams: Unigram, Bigram, Trigram, N-gram language model (basic concept), Applications of N-grams: Text prediction, Spelling correction.

Unit-III Syntactic Analysis and Sequence Modeling 7 Hrs.

Part-of-speech tagging and tag sets, rule-based POS tagging, stochastic POS tagging, issues in POS tagging (multiple tags and unknown words), context-free grammar, sequence labelling using Hidden Markov Models, Maximum Entropy models and Conditional Random Fields.

Unit-IV Semantic Analysis 8 Hrs.

Lexical semantics, word senses and semantic relations, homonymy, polysemy, synonymy and hyponymy, lexical resources such as WordNet, word sense disambiguation techniques (WSD), semantic role labelling and semantic representation in natural language processing. Knowledge based approach (Lesk ‘s Algorithm), Supervised (Naïve Bayes, Decision List).

Unit-V Pragmatics and Discourse Processing 5 Hrs.

Pragmatics in natural language processing, discourse analysis, reference resolution, reference phenomena in discourse, syntactic and semantic constraints on coreference, coreference resolution techniques, applications of discourse processing in NLP. Anaphora Resolution using Hobbs and Centering Algorithm. Characteristics and challenges of Indian languages:

- Morphological richness
- Free word order
- Script diversity (Devanagari, Bengali, Tamil, Telugu, Gujarati, etc.)
- Code-mixing and code-switching (e.g., Hinglish)

Natural Language Processing Laboratory (RCP23ELMD701)

List of Laboratory Experiments: (Minimum Eight)

1. To Perform Text Pre-processing in NLP: Tokenization, stop word Removal, Lemmatization, stemming using NLTK and SPACY
2. To Implement Named Entity Recognition for any given text:
3. To Perform Part-of-Speech Tagging
4. To Perform Chunking and Named Entity Recognition:
5. To Implement regular expressions for text processing.
6. To Implement N-gram Language Model
7. To Implement Minimum, Edit Distance
8. To Perform Word Sense Disambiguation
9. To Perform Sentiment Analysis
10. Mini Project

(A mini project to be undertaken by a group of 4–5 students, focusing on topics related to the subject. Any application of NLP: Spell Check, Autocorrect, plagiarism detection, sentiment analysis, sarcasm detection or text analytics in any domain.)

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Text Books

1. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 1st Edition, 2009.
2. Speech and Language Processing – Daniel Jurafsky & James H. Martin, 3rd Edition, Stanford University, 2023

Reference Books / online Courses

1. Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1st Edition, 1999.
2. Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019.
3. Lewis Tunstall, Leandro von Werra and Thomas Wolf, Natural Language Processing with Transformers, O'Reilly Media, 1st Edition, 2022.

Online References:

1. Natural language toolkit- https://www.nltk.org/
2. https://www.deeplearning.ai/resources/natural-language-processing/
3. https://web.stanford.edu/~jurafsky/slp3/?utm_source=chatgpt.com

Online Courses: NPTEL / Swayam:

1. Natural Language Processing by Prof. Pawan Goyal, IIT Kharagpur,

https://onlinecourses.nptel.ac.in/noc21_cs102/preview

2. Applied Natural Language Processing, By Prof. Ramaseshan R, CMI, https://onlinecourses.nptel.ac.in/noc20_cs87/preview
3. Cousera: https://www.coursera.org/specializations/natural-language-processing
4. Udemy: https://www.udemy.com/course/nlp-natural-language-processing-with-python/

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Research Ecosystem (RCP23ITELX08)	

Pre-requisite:

- Basic understanding of Engineering concepts and problem-solving techniques.
- Fundamental knowledge of project-based learning, data analysis, and domain-specific tools.
- Basic exposure to project development, technical report writing, and emerging technologies.

Course Objectives:

- To understand and identify complex engineering, societal, and industrial problems suitable for research through structured analysis of literature, patents, and real-world needs.
- To learn and apply advanced research methodologies—including experimental, simulation-based, and data-driven approaches—for designing and validating engineering solutions.
- To gain proficiency in selecting and using appropriate tools, software, and platforms (AI/ML, simulation, CAD, IoT, etc.) for experiment design, data acquisition, and performance evaluation.
- To transform research insights into innovative prototypes, products, or start-up concepts by engaging with innovation ecosystems, TRLs, and funding mechanisms.
- To analyze socio-technical systems, ethics, and sustainability implications of engineering solutions, ensuring responsible and impactful outcomes.
- To integrate systems thinking, multidisciplinary perspectives, policy awareness, future technology trends, and technical documentation skills to develop comprehensive research proposals and outputs (papers, patents, reports).

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze complex engineering and societal problems through literature and patents analysis to identify research gaps.	L4	Analyze
CO2	Apply advanced research methods and tools to acquire data and assess solution performance.	L3	Apply
CO3	Apply innovation frameworks and Technology Readiness Levels (TRL) for prototype and startup development.	L3	Apply
CO4	Analyze ethical, socio-technical, and sustainability issues related to engineering solutions.	L4	Analyze
CO5	Analyze multidisciplinary knowledge for engineering research proposal preparation.	L4	Analyze

Research Ecosystem

COURSE CONTENTS

Unit-I Research Gap Identification & Advanced Problem Formulation 5 Hrs.

Identifying high-impact problems from:

- Industry and Society
- Emerging technologies (AI, IoT, Blockchain, EV, etc.)

Research gap identification techniques:

- Systematic Literature Review (SLR)
- Patent analysis

Defining objectives, scope, constraints, and feasibility of the identified problem

- Writing problem statement for:
- Research paper
- Product/Start-up idea

Activities:

- Convert Industry/ Societal problem into research problem.
- Analyze research articles and extract research gaps.

Unit-II Experimental Design, Tools & Validation Techniques 5 Hrs.

Advanced research methodologies:

- Experimental, simulation, data-driven, design thinking
- Tool selection:
- Computational tools and software, simulation and analysis platforms, system prototyping and testing platforms
- Data acquisition:
- Data collection interfaces, Principles of data cleaning and organization (primary / secondary data)

Validation techniques:

- Accuracy and performance metrics
- Benchmarking with existing solutions
- Result interpretation & visualization

Activities:

- Selection of Research Design for final year project.
- Apply evaluation metrics (e.g., ML model accuracy, system efficiency).

Unit-III Research to Innovation, Product & Startup Ecosystem 6 Hrs.

- Research → Prototype → Product → Startup lifecycle
- Intellectual Property Rights (IPR), patents, copyrights
- Technology readiness levels (TRL)
- AI start-ups, EV ecosystem, Smart Cities
- Industry-academia collaboration models
- Funding opportunities (grants, incubation, government schemes - Anusandhan National Research Foundation (ANRF))

Activities:

- Convert project into startup idea or product pitch.
- Analyze failure of a technology/product.

Unit-IV Socio-Technical Systems, Ethics & Sustainability 6 Hrs.

- Socio-technical systems: Interaction of people, technology and environment
- Ethical issues:
- Plagiarism, AI bias, data privacy
- Sustainability in Engineering:
- Green practices, resource optimization and lifecycle considerations
- Impact assessment:
- Social, economic, environmental
- Policies and governance (data protection laws, standards and compliance requirements)

Activities:

- Case study: Facial recognition ethics / smart surveillance.
- Impact analysis of student's own project.

Unit-V Integrated Research, Policy and Future Engineering Challenges 6 Hrs.

- Systems thinking and holistic analysis
- Multidisciplinary problem solving:
- Healthcare tech, climate tech, smart mobility
- Writing research proposals: Problem → Methodology → Expected outcomes

Future trends:

- AI ethics, Quantum computing, Industry 5.0 / 6.0
- Scaling solutions from lab to society

Activities:

- Capstone Task:
- Identify real-world problem.
- Apply research methodology.

Propose:

- Technical solution
- Societal impact
- Possible commercialization

Term Work Guidelines:

The Term Work (TW) shall consist of continuous assessment based on tutorials activities and a final group presentation.

A. Part A (25 Marks): Each student shall complete a minimum of five tutorials based on the syllabus topics during the semester. The tutorials may include activities such as research gap identification, literature survey, case study analysis, tool-based experimentation, impact analysis, technical report writing, and innovation-oriented problem solving.

B. Part B (25 Marks): Students shall work in groups and select a project/research topic based on emerging engineering, industrial, or societal challenges. The group presentation shall include:

- Identification of a real-world problem
- Application of appropriate research methodology
- Proposed technical solution
- Analysis of societal impact
- Possible commercialization/startup opportunities

Reference Books

1. Kothari, C. R., Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi, 2023.
2. Booth, W. C., Colomb, G. G., Williams, J. M., Bizup, J., & FitzGerald, W. T., The Craft of Research, University of Chicago Press, Chicago, 2024.
3. Montgomery, D. C., Design and Analysis of Experiments, Wiley, New York, 2020.
4. Singh, Pooja, Katiyar, Aman, Rawat, Shalini, Dhuri, Archana, Research Methodology and IPR, RK Publications, India, 2025.
5. Blok, Vincent (Ed.), Putting Responsible Research and Innovation into Practice: A Multi-Stakeholder Approach, Springer Cham, Switzerland, 2022.

Online References:

- Research Methodology: Quantitative Methods and Computer Application (https://onlinecourses.swayam2.ac.in/e-learning/preview/ini26_ma02)
- Research Methodology and IPR (https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed28)
- Research and Publication Ethics (https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ge46)
- Research Ethics and Plagiarism (https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ge26)
- Quantitative and Mixed Methods Research for Management (https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg21)
- Doing Qualitative Research (https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ge61)

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VII
Project Stage - II (RCP23IPEL701)	

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 use proper referencing styles.	L2	Apply

Project Stage - II (RCP23IPEL701)

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-VII
Disaster Management and Preparedness (RCP23ICHSX09)	

Course Objectives:

- To provide basic understanding of hazards, disasters 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 organizations 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	Apply disaster management principles & guidelines.	L3	Apply
CO2	Analyze risk assessments.	L4	Analyze
CO3	Demonstrate community awareness & participation.	L3	Apply
CO4	Utilize Science & Technology tools (GIS, GPS).	L3	Apply
CO5	Prepare disaster management plans.	L3	Apply

Disaster Management and Preparedness (RCP23ECMC701)

COURSE CONTENTS

Unit-I Understanding Disasters & Hazards 6 Hrs.

- Definition and types of disasters: Natural, Man-made and hybrid disasters, 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,
- Hazard & Vulnerability profiles of India (seismic zones, flood-prone areas).
- India's vulnerability to disasters, and the impact of disasters on National development.

Unit-II Disaster Risk Reduction (DRR) & Mitigation 6 Hrs.

- Disaster Management Cycle: Prevention, Mitigation, Preparedness, Response, Recovery. Need for disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.
- Risk Assessment & Vulnerability Analysis.
- Science & Technology: Use of information management, Geo informatics like RS, GIS, GPS and remote sensing mitigation measure.

Unit-III Disaster Preparedness & Response 4 Hrs.

- Preparedness Planning, Early Warning Systems (EWS), & Communication.
- Emergency Response: Search & Rescue, Logistics, Medical Aid.
- Psychological Response & Management (Trauma, Stress).
- Role of IT, Media, Govt., NGOs, & Community.

Unit-IV Recovery, Rehabilitation & Reconstruction 4 Hrs.

- Post-disaster damage assessment.
- Rehabilitation, Reconstruction, & Livelihood Restoration.
- Sanitation, Hygiene, & Waste Management.

Unit-V Policy, Governance & Capacity Building 4 Hrs.

- National Disaster Management Authority (NDMA) & Legislation.
- Institutional Mechanisms & Community Mobilization. Non-Structural Mitigation: Community based disaster preparedness, capacity development and training, awareness and education, contingency plans.

Unit-VI Case studies on disaster (National /International) 4 Hrs.

- Case study discussion of National Disasters: Tsunami (2004), Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, 26th July 2005 Mumbai flood
- Case study discussion of International Disasters: Hiroshima – Nagasaki (Japan), Cyclone Phailin (2013), Fukushima, Daiichi nuclear disaster (2011), Chernobyl meltdown

Books Recommended:

Reference Books and Reports:

1. Disaster Management, by Harsh K. Gupta, Universities Press Publications (2003).
2. Disaster Management: An Appraisal of Institutional Mechanisms in India, by O. S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. Introduction to International Disaster Management, by Damon Copolla, Butterworth Heinemann Elsevier Publications (2015).
4. Disaster Management Handbook, by Jack Pinkowski, CRC Press, Taylor and Francis group (2008).
5. Disaster management & rehabilitation, by Rajdeep Dasgupta, Mittal Publications, New Delhi (2007).
6. Natural Hazards and Disaster Management, Vulnerability and Mitigation, by R B Singh, Rawat Publications (2006).
7. Concepts and Techniques of GIS, by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications (2006).
8. Risk management of natural disasters, by Claudia G. Flores Gonzales, KIT Scientific Publishing (2010).
9. Disaster Management – a disaster manger's handbook, by W. Nick Carter, Asian Development Bank (2008).
10. Disaster Management in India, by R. K. Srivastava, Ministry of Home Affairs, GoI, New Delhi (2011)
11. The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy, by Wil Mara, Marshall Cavendish Corporation, New York, 2011.
12. The Fukushima 2011 Disaster, by Ronald Eisler, Taylor & Francis, Florida, 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
Generative AI and Large Language Models (RCP23ECSC701) **(Cousera Course)**	

Course Objectives:

- To introduce the fundamentals, architectures, and applications of Generative AI models.
- To develop knowledge of Large Language Models (LLMs) and Transformer architectures.
- To enable the design and implementation of practical LLM-based applications using modern techniques and tools.
- To explore diffusion models and their applications in image generation.
- To familiarize learners with multimodal AI systems integrating text, image, and audio data.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the fundamental concepts, architectures, applications, and ethical considerations of Generative AI models including GANs, VAEs, Transformers, and Diffusion Models.	L4	Analyze
CO2	Analyze the architecture and working principles of Large Language Models (LLMs) and Transformer-based networks.	L4	Analyze
CO3	Design and implement LLM-based applications using fine-tuning, Retrieval-Augmented Generation (RAG), structured outputs, and API integration.	L6	Create
CO4	Design and evaluate diffusion-based generative models for image synthesis and compare their performance with GAN and VAE approaches.	L6	Create
CO5	Create multimodal AI solutions by integrating text, image, and audio data using vision-language and speech-based models.	L6	Create

Generative AI and Large Language Models (RCP23ECSC701)

COURSE CONTENTS

Unit-I **Introduction to Generative AI** **5 Hrs.**

- Take your first steps into the exciting world of generative AI, where you'll distinguish between various model types including GANs, VAEs, transformers, and diffusion models.
- You'll explore the evolution of generative technologies and examine their real-world applications while considering important ethical implications that accompany these powerful tools.

Unit-II **Large Language Models (LLMs) and Transformer Architecture** **5 Hrs.**

- Explore the revolutionary transformer architecture that powers today's most advanced language models.
- You'll gain hands-on experience with self-attention mechanisms, learn how transformers process and generate text, and experiment with fine-tuning using Hugging Face Transformers.
- This module bridges theory with practical implementation, equipping you with skills to work directly with cutting-edge LLM technology.

Unit-III **Hands on Applications of LLMs** **6 Hrs.**

- Take your LLM knowledge to the next level with practical applications that power modern AI systems.
- You'll implement retrieval-augmented generation to enhance responses with external knowledge, use structured output techniques for consistent formatting, and deploy models through APIs.
- This module tackles both the theory and practice behind modern LLM applications, showing you how to build real-world applications with today's most advanced language models.

Unit-IV **Diffusion Models** **5 Hrs.**

- Discover the technology behind today's most impressive image generation systems.
- You'll learn how diffusion models gradually transform random noise into stunning visuals through an iterative denoising process.
- Through practical coding exercises, you'll implement your own diffusion model using PyTorch, explore Stable Diffusion for text-to-image generation, and compare diffusion with earlier approaches like GANs and VAEs to understand why diffusion has become the dominant paradigm in visual generation.

Unit-V **Multimodal Generative AI** **7 Hrs.**

- Discover how cutting-edge AI models can integrate text, images, and audio to create truly multimodal experiences.
- You'll investigate vision-language models like CLIP and BLIP that understand relationships between text and images, implement audio-based AI with Whisper for speech recognition, and gain hands-on experience building systems that can process multiple types of data simultaneously.
- This module prepares you for the increasingly multimodal future of generative AI where models seamlessly combine different kinds of information.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem- VIII
Next Generation Networks (RCP23ECPE811)	

Pre-requisite:

- Analog & Digital Communication
- Computer Networks

Course Objectives:

- To provide a working knowledge of emerging network technologies in Next Generation Networks.
- Understand the advantages or disadvantages of future offers with integration of Next Generation Networks.
- Consider the business potential for current and future services.
- Summarize architecture and technology options for Multi-Service Networks.
- Identify the key technologies for core, access, and infrastructure.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe technical features and design considerations of the next generation of networks.	L2	Understand
CO2	Demonstrate technologies for next generation networks.	L3	Apply
CO3	Identify the NGN services in business-oriented aspects.	L1	Remember
CO4	Evaluate the performance and management of Next Generation Networks.	L5	Evaluate

Next Generation Networks (RCP23ECPE801)

COURSE CONTENTS

Unit-I Introduction to Next Generation Network and ITU standards 10 Hrs.

Introduction Evolution of Next Generation Networks, ITU SG13 NGN standards, All-IP network concept, Numbering, naming and addressing for all NGN, NGN control architectures and protocols, Transport Stratum, Service Stratum, Service Management, Application Functions. Wireless NG Technologies.

Transition of IP networks to NGN, Future packet-based network. IPv6 NGN implementation, NGN business challenges.

Unit-II IMS in NGN IP Multimedia Subsystem (IMS) 10 Hrs.

IMS architecture, IMS operation, Call Session Control function (CSCF) and its components, HSS database. SIP for IMS. QoS Control and Authentication, Network and Service management for NGN, IMS advantages.

Next Generation OSS Architecture - standards important to OSS architecture, Information framework, and OSS interaction with IMS, NGN OSS function / information view reference model, DMTF CIM.

Unit-III MPLS AND VPN 8 Hrs.

Technology overview –MPLS &QoS, MPLS services and components layer 2 VPN, layer 2 Internet working, VPN services, IPv6 and MPLS Technology overview, Future of MPLS – Integrating IP and optical networks, Future Layer2 layer3 services.

VPN, layer Internetworking, VPN services, signalling, layer 3 VPN Technology overview, Remote Access, and IPsec integration with MPLS VPN. VPN services in NGN with emerging Internet of Things (IoT) and Web of Things (WoT).

Unit-IV NGN Services 8 Hrs.

Technology, Business Aspects: VoIP, IPTV, rich multimedia, future web, Quality of Service (QoS), Quality of Experience (QoE) in NGN.

Control and Signaling protocols for NGN, NGN security, Service convergence, Business, and regulatory aspects of NGN, Ubiquitous Sensor Network Services-USN Functional Architecture, USN Applications, Business models and regulation of the NGN services.

Unit-V NGN Management 6 Hrs.

Network Management and Provisioning Configuration, Accounting, performance, security, case study for MPLS, Future enhancements Adaptive self-healing networks.

Text Books

1. Thomas Plavyk, Veli Sahin, “Next generation Telecommunication Networks, Services and Management”, Wiley and IEEE Press Publications, 2010.
2. Neill Wilkinson, “Next Generation Network Services: Technologies and Strategies", John Wiley Publications, 2002.
3. Gerardus Blokdyk, “Next Generation Networks A Complete Guide”, 5 STAR Cooks, 2020 Edition

Reference Books

1. Monique J. Morrow,” Next Generation Networks”, CISCO Press, 2007.
2. Robert Wood, “MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization", CISCO Press, 2006.
3. Toni Janevski, “NGN Architectures, Protocols and Services”, John Wiley and Sons,2014.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem- VIII
Remote Sensing (RCP23ECPE812)	

Pre-requisite:

- Analog & Digital Communication
- Digital Signal Processing
- Digital Image Processing

Course Objectives:

- To understand the principles, components, and working of remote sensing systems and satellite platforms.
- To study sensors and remote sensing data acquisition techniques used for geospatial applications.
- To apply digital image processing techniques for enhancement, analysis, and interpretation of satellite images.
- To explore intelligent remote sensing applications using geospatial analysis and AI/ML techniques in environmental, agricultural, and smart city domains.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the principles, components, and working of remote sensing systems.	L2	Understand
CO2	Study satellite platforms, sensors, and remote sensing data acquisition techniques.	L2	Understand
CO3	Apply digital image processing techniques for enhancement and interpretation of satellite images.	L3	Apply
CO4	Analyze and interpret geospatial data for remote sensing applications.	L4	Analyze
CO5	Explore intelligent remote sensing applications using AI/ML techniques in smart city, environmental, and surveillance domains.	L5	Evaluate

Remote Sensing (RCP23ECPE802)

COURSE CONTENTS

Unit-I Principles of Remote Sensing and Space borne Systems 08 Hrs.

Introduction to remote sensing, Components of remote sensing system, Active and passive remote sensing, Electromagnetic spectrum and spectral signatures, Atmospheric interaction with electromagnetic radiation, spatial, spectral, temporal, and radiometric resolutions

Remote sensing platforms: Ground based, Airborne, Space borne Satellite systems and applications: IRS, CARTOSAT, RESOURCESAT, INSAT, Introduction to GPS and GIS.

Unit-II Remote Sensing Sensors and Geospatial Data Acquisition 08 Hrs.

Sensors: Optical, thermal, microwave sensors, and LiDAR sensors CCD and CMOS imaging sensors, Sensor characteristics and calibration

Satellite image acquisition process: Data formats and storage techniques, Remote sensing data pre-processing, Noise sources in satellite images Introduction to geospatial datasets: Data communication and transmission in remote sensing systems. UAV and drone-based remote sensing systems

Unit-III Digital Image Analysis for Remote Sensing 8 Hrs.

Image representation and visualization, Histogram processing and equalization, Image enhancement techniques, Spatial filtering and smoothing, Frequency domain concepts, Edge detection techniques, Image segmentation methods, Morphological image processing, Feature extraction techniques for satellite images, Change detection in satellite imagery

Unit-IV Geospatial Data Interpretation and Intelligent Remote Sensing 10 Hrs.

Geospatial Data Analysis: Feature-based analysis, Spectral analysis of land cover, Temporal analysis of satellite data, Pattern recognition in remote sensing images, Hyperspectral and LiDAR data analysis, Fusion of multi-modal remote sensing data.

Remote Sensing Data Visualization: False color composites, Thematic mapping, Heat maps and terrain visualization,

Intelligent Remote Sensing: Introduction to AI in remote sensing, Machine learning workflow for image classification, Supervised and unsupervised classification for satellite image analysis. Cloud-based Geospatial Platforms: Introduction to Google Earth Engine, Real-time geospatial data analysis concepts,

Unit-V Advanced Applications and Emerging Trends in Remote Sensing 8 Hrs.

Smart city monitoring, Precision agriculture and crop monitoring

Environmental and pollution monitoring, Disaster management and flood mapping, Weather

forecasting applications, Forest and water resource monitoring, Traffic and urban planning, Defence and surveillance applications, IoT integrated remote sensing systems, Cloud platforms for geospatial analytics, Introduction to Google Earth Engine, Future trends in AI-enabled remote sensing

Text Books

1. Paul J Gibson, Clare H Power and John Keating, "Introductory Remote Sensing - Principles and Concepts", Routledge, 2000.
2. F.F. Sabins Jr, W.H. Freeman & Co., "Remote Sensing - Principles and Interpretation", 3rd Edition, New York, 1997.
3. J. A. Richards, "Remote Sensing Digital Image Analysis", Springer Nature, 6th Edition, 2022.
4. C. H. Chen, "Signal and Image Processing for Remote Sensing", CRC Press, 3rd Edition, 2024.
5. Gwanggil Jeon (Ed.), "Advanced Machine Learning and Deep Learning Approaches for Remote Sensing II", MDPI AG, 1st Edition, 2024.

Reference Books

1. John B Campbell, "Introduction to Remote Sensing", Guilford Publications, 2011.
2. D. G. Manolakis and R. B. Lockwood, "Hyperspectral Imaging Remote Sensing", Cambridge University Press, 1st Edition, 2016.
3. Alka Rani, Nirmal Kumar, S. K. Singh, N. K. Sinha, R. K. Jena and Himesh Patra, "Remote Sensing Data Analysis Using R", CRC Press, Taylor & Francis Group, 1st Edition, 2021.
4. Yakoub Bazi and Edoardo Pasolli (Eds.), "Advanced Deep Learning Strategies for the Analysis of Remote Sensing Images", MDPI AG, 1st Edition, 2021.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem- VIII
Audio and speech Processing (RCP23ECPE813)	

Pre-requisite:

- Signals and Systems
- Digital Signal Processing

Course Objectives:

- Understand the anatomy and Physiology of Speech Production system and perception model.
- To study the parameters of the speech in time and frequency domains.
- To provide analysis of speech using LPC parameters, the concept of homomorphic system, enhancement of speech and Speech Recognition.
- To understand the applications of Filter banks in speech analysis.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Characterize Speech and audio signal production and perception mechanisms.	L2	Understand
CO2	Analyze speech and audio signals in the time and frequency domains.	L4	Analyze
CO3	Design LPC coder and other codes.	L3	Apply
CO4	Develop speech processing solutions based on filter banks	L3	Apply
CO5	Design speech recognition, speaker identification, and speech synthesis schemes.	L3	Apply

Audio and speech Processing (RCP23ECPE803)

COURSE CONTENTS

Unit-I **Mechanics of speech and audio** **08 Hrs.**

Speech production mechanism, nature of Speech signal, Digital Model of speech signals. Classification of Speech sounds: Phones, Phonemes, Phonetic and Phonemic alphabets, vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates. Anatomical pathways from the ear to perception of sound, The peripheral auditory system. Absolute Threshold of Hearing.

Unit-II **Speech Analysis** **08 Hrs.**

Short-Time Speech Analysis: Windowing, Spectra of Windows, Time-Domain Parameters: signal analysis in Time Domain, Short-Time average magnitude, Short-Time Average zero-crossing rate (ZCR) and Short-Time auto correlation function Short-Time Average Magnitude Difference Function, Frequency Domain (Spectral) Parameters: Short-Time Fourier Transform Analysis, Spectral Displays, Formant
Estimation and Tracking.

Unit-III **Linear predictive coding (LPC) of Speech** **10 Hrs.**

Introduction, Basic principles of Linear Predictive Analysis, Solution of the LPC Equation: Cholesky Decomposition Solution for covariance method, Durbin's Recursive Solution for the Autocorrelation Equations. Frequency domain interpretation of mean squared prediction error, Applications of LPC parameters: pitch detection using LPC parameters, and Formant analysis using LPC parameters. Pitch Period Estimation using Parallel Processing Approach, Pitch Period Estimation using Autocorrelation Function.

Unit-IV **Frequency Analysis, Homomorphic Speech processing** **10 Hrs.**

Homomorphic Speech processing: Introduction, Homomorphic systems for Convolution, The complex cepstrum of speech, The Homomorphic Vocoder. Speech enhancement: Introduction, Background, Nature of interfering sounds, speech enhancement techniques: spectral subtraction, Multi-Microphone Adaptive Noise Cancellation.

Unit-V **Speech Recognition** **6 Hrs.**

Basic pattern recognition approaches, Pre-processing, Parametric Representation, speech recognition systems: Isolated Digit Recognition system and continuous Digit Recognition system. Speaker Recognition: Verification vs recognition, Speaker Recognition Systems: speaker verification system and speaker identification system.

Text Books

1. Douglas O'Shaughnessy, “Speech Communications: Human & Machine”, 2nd Edition, University Press, 1999.
2. Rabiner and Schafer, “Digital Processing of Speech Signals”, 3rd Edition, Prentice Hall, 1978.

Reference Books

1. Thomas F. Quatieri, “Discrete-Time Speech Signal Processing: Principles and Practice”, 3rd Edition, Prentice Hall, 2001.
2. Nelson Morgan and Ben Gold, “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, 2nd Edition, John Wiley & Sons, 2011.
3. J. L. Flanagan, “Speech Analysis Synthesis and Perception”, 2nd Edition, Springer-Verlag, 1972.
4. Gold & Morgan, “Speech and Audio Signal Processing”, 2nd Edition, Wiley and Sons, 1999.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem- VIII
Internet Engineering and Network Security (RCP23ECPE814)	

Pre-requisite:

- Computer Networks

Course Objectives:

- To understand Internet application protocols, addressing mechanisms, and network layer services used in modern communication networks.
- To study multimedia communication protocols and Quality of Service (QoS) techniques for real-time applications
- To understand network security principles, protocols, and mechanisms for secure data communication.
- To introduce network security solutions, security operations, and emerging security applications for protecting network infrastructures.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze Internet protocols, addressing mechanisms, and network layer services for efficient communication and network design.	L4	Analyze
CO2	Analyze multimedia communication protocols and Quality of Service (QoS) techniques.	L4	Analyze
CO3	Analyze network security protocols and mechanisms for secure data communication.	L4	Analyze
CO4	Evaluate network security solutions and emerging security applications for protecting network infrastructures.	L5	Evaluate

Internet Engineering and Network Security (RCP23ECPE804)

COURSE CONTENTS

Unit-I **Introduction to Application layer protocols** **08 Hrs.**

Review of TCP/IP layer functions, Application Layer protocols: HTTP, DHCP, DNS, FTP, TFTP, SMTP, MIME, IMAP, POP3, TELNET, SSH.

Unit-II **Network Layer** **06 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** **08 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: Scheduling, Token bucket, Leaky bucket.

Unit-IV **Security in Networks** **08 Hrs.**

Introduction to Information Security, Network Security Domains, Attacks and their classification, Security services and mechanisms, 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 and Intrusion Detection Systems** **6 Hrs.**

Firewall concepts and design principles, types of firewalls: packet filtering firewall, stateful inspection firewall, application gateway firewall, firewall architectures and configurations, intrusion detection systems (IDS), host-based intrusion detection systems (HIDS), network-based intrusion detection systems (NIDS), intrusion prevention systems (IPS), honeypots and honeynets.

Unit-VI **System Security and Emerging Security Applications** **6 Hrs.**

Security operations and incident response, network security audit, cloud security fundamentals, mobile and cellular security, security management, cyber security challenges in emerging networks, case studies of network security incidents.

Text Books

1. B. F. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill, 6th Edition, 2008.
2. William Stallings, “Network Security Essentials: Applications and Standards”, Pearson Education, 7th Edition, 2023.

Reference Books

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson Education, 8th Edition, 2023.
2. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach”, Pearson Education, 8th Edition, 2021.
3. Charles P. Pfleeger and Shari Lawrence Pfleeger, “Security in Computing”, Pearson Education, 6th Edition, 2024.
4. Andrew S. Tanenbaum and David J. Wetherall, “Computer Networks”, Pearson Education, 6th Edition, 2021.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem- VIII
Internship (OJT) cum Project (RCP23IPELX10)	

Prerequisite:

1. Fundamental knowledge of engineering concepts and programming
2. Basic understanding of professional ethics and communication skills
3. Exposure to laboratory courses and mini-projects
4. Teamwork and problem-solving skills

Course Objectives:

1. To provide practical exposure to industrial and professional environments.
2. To bridge the gap between academic learning and industry practices.
3. To develop technical, communication, teamwork, and managerial skills.
4. To enable application of engineering knowledge for solving real-world problems.
5. To familiarize students with modern tools, technologies, and professional ethics.
6. To prepare students for industry-oriented careers through project implementation and professional experience.

Course Outcomes: On completion of the course, learner will be able to:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply engineering knowledge and technical skills in industrial environments.	L3	Apply
CO2	Analyze and solve practical engineering problems using appropriate tools and techniques.	L4	Analyze
CO3	Demonstrate professional ethics, teamwork, communication, and organizational skills	L3	Apply
CO4	Utilize modern engineering tools and technologies for assigned tasks and projects.	L3	Apply
CO5	Prepare technical reports, presentations, and project documentation effectively.	L6	Create
CO6	Adapt to professional work culture and demonstrate readiness for professional careers.	L3	Apply

Internship (OJT) cum Project (RCP23IPELX10)

Course Contents

Overview of the OJT Process

The On-Job Training (OJT) program begins with an introduction to workplace ethics, safety practices, organizational culture, and professional conduct to prepare students for industrial environments. Students are then exposed to industrial processes, workflow practices, tools, and modern technologies relevant to their domain of study.

During the technical training phase, students work on assigned industrial tasks and projects under the guidance of faculty mentors and industry supervisors. The program emphasizes the application of engineering concepts, teamwork, communication skills, and problem-solving abilities in real-world professional settings.

The later stages of the OJT focus on project implementation, report writing, technical documentation, and presentation preparation. Students are required to maintain logbooks and progress records throughout the training period. At the end of the semester, students present their project work through demonstrations and viva-voce examinations, followed by comprehensive evaluation and feedback.

Internship (OJT) Schedule, Duration and Credits

The Internship / On-Job Training (OJT) cum Project is an integral part of the Final Year B.Tech. program and carries a total of 18 academic credits toward completion of the degree requirements.

Each credit corresponds to 40 hours of work, resulting in approximately 550–600 hours of industrial training and project work over one semester.

The full-time OJT program is conducted during the designated semester as per the academic schedule. The duration of the OJT is one complete semester in the final year. Faculty mentors are assigned for mentoring, monitoring, and evaluating students throughout the OJT period.

Approximately 50% of the students undergo OJT during Semester VII while the remaining students continue academic activities in the institute. In Semester VIII, the arrangement is interchanged to ensure equal academic and industrial exposure for all students.

To avoid academic scheduling conflicts and ensure fair evaluation, oral, practical, and End Semester Examinations for both Semester VII and Semester VIII will be conducted at the end of Semester VIII. Students are issued a combined mark sheet covering both semesters.

Types of External OJT Opportunities

Sr. No	Type of OJT	Examples / Description
1	Industry OJT	Industrial internships with or without stipend.
2	Government / PSU OJT	BARC, SAMEER, Railways, ISRO, etc.
3	Research OJT	IITs, NITs, IISc, IIMs, and other research institutes.
4	Institute-Based OJT	OJT at institutes approved by RCPIT and departments.
5	Other Approved OJT	Any approved industrial/research work relevant to the domain.

OJT / Internship Sources

To facilitate OJT and internship opportunities, AICTE has signed Memorandums of Understanding (MoUs) with various industries, government organizations, and training institutions. These collaborations provide students with industrial exposure, skill development opportunities, research internships, and professional training through multiple recognized platforms and organizations.

Students may also approach organizations such as the Board of Apprenticeship Training (BOAT) and Board of Practical Training (BOPT) for additional training opportunities.

Major OJT / Internship Sources

Sr. No.	Organization / Platform	Nature of Opportunity
1	Internshala	Internship and industry training opportunities
2	NETiit (Taiwan)	International internship opportunities
3	HireMee	Skill-based internships and employability support
4	IGNCA	Research and cultural project opportunities
5	CCEI, Republic of Korea	International innovation and creative economy internships
6	IIWM, Bangalore	Waste management and sustainability projects
7	Engineering Council of India (ECI)	Engineering and professional development

		activities
8	Fourth Ambit	Industry training and technical internships
9	LinkedIn	Professional networking and internship opportunities
10	Telecom Sector Skill Council (TSSC)	Telecom and communication technology training
11	SCHOLARSMERIT	Internship and skill enhancement programs
12	Studenting Era	Student internship and academic support activities
13	MSME	Industry exposure and entrepreneurship opportunities
14	BOAT	Apprenticeship and industrial training programs
15	BOPT	Practical and apprenticeship-based training opportunities

Evaluation Metrics

Sr. No.	Evaluation Component	Marks
1	Internal Review 1	100
2	Final Internal Review	100
3	End Semester Evaluation (OJT Viva / Presentation)	200
Total		**400**

Evaluation Parameters

The student shall be evaluated based on the following parameters:

- Understanding of assigned work.
- Progress and task completion.
- Technical skill development.
- Learning ability and initiative.
- Professional behaviour and discipline.
- Communication and presentation skills.
- Problem solving and contribution.

- Quality of work and innovation.
- Logbook maintenance and report documentation.
- Application of engineering knowledge.

Necessary Documents

Students are required to submit and maintain the following documents during the OJT period:

1. No Objection Certificate (NOC)
2. Undertaking for opting OJT
3. OJT Joining Form
4. Parent/Guardian Undertaking Form
5. Contact Details and OJT Objectives Form
6. Student Logbook / Daily Activity Record
7. Internal Review Evaluation Sheets
8. External Supervisor Evaluation Form
9. Internal Supervisor Feedback Form
10. Student Feedback Form
11. SDG Mapping Form
12. Final OJT Report and Presentation
13. OJT Completion Certificate

Scheme of Examination

Component	Marks
Continuous Internal Assessment	200
End Semester OJT Evaluation (Report and Presentation)	200
Total	**400**

Credits

- Total Credits: 18
- 1 Credit = 40 Hours of Work

- Minimum Duration: 550–600 Hours of OJT and Project Work over one semester.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem- VIII
Satellite Communication (RCP23ECPE815)	

Pre-requisite:

- Mathematics for Telecommunication Engineering
- Wave Theory & Radio Frequency Design
- Analog & Digital Communication
- Control Systems

Course Objectives:

- To understand the basics of satellite communications and different satellite orbits.
- 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 satellite communication.
- 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 basics of satellite communication, space segment and earth segment.	L2	Understand
CO2	Analyze different satellite orbits and orbital parameters.	L4	Analyze
CO3	Design and analyze link budget of satellite signals for proper communication.	L6	Create
CO4	Evaluate various applications of satellite communication systems.	L5	Evaluate

Satellite Communication (RCP23ECPE805)

COURSE CONTENTS

Unit-I Overview of Satellite Systems, Orbits and Launching 10 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 08 Hrs.

Satellite subsystems: Transponder sub-system, Antenna subsystem, AOC Sub-system, TT&C Sub-system, power sub-system, Thermal sub-system, reliability and quality Assurance. Satellite stabilization and stabilization techniques. Numericals on transponder design, power sub-system design.

Unit-III Earth station 06 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 ionosphere 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 and receiver, satellite beam acquisition, tracking & positioning.

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, 4th Edition, 2018.
2. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, "Satellite Communication Systems Engineering", Pearson Publication, 3rd Edition, 2016.
3. Timothy Pratt, Jeremy E. Allnutt, "Satellite Communications", John Willy & Sons,3rd Edition, 2019.

Program: Electronics and Telecommunication Engineering	Final Year B. Tech
	Sem-VIII
AI for Telecommunications (RCP23ECSC801)	
(Coursera Course)	

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

- To introduce the fundamental concepts of wireless communications, 5G networks, and their key technologies, architectures, and applications.
- To develop an understanding of telecom data engineering concepts, including data processing, data pipelines, and modern data engineering tools used in telecommunications.
- To explain the role of Artificial Intelligence in 5G networks for intelligent network management, traffic optimization, and Quality of Experience (QoE) enhancement.
- To examine AI-driven approaches for enhancing telecom network performance, predictive maintenance, and resource management through real-world case studies.
- To familiarize learners with AI-based cybersecurity solutions, fraud detection techniques, and advanced security frameworks for securing next-generation telecom networks.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamentals of wireless communications, 5G technologies, and network architecture.	L2	Understand
CO2	Apply data engineering techniques and telecom data pipeline management using appropriate tools.	L3	Apply
CO3	Analyze AI applications for 5G network optimization, traffic management, and performance enhancement.	L4	Analyze
CO4	Evaluate AI-based security and fraud detection techniques for telecommunication networks.	L5	Evaluate

Course 1: 5G for Everyone

COURSE CONTENTS

Unit-I **Overview of wireless and cellular communications.** **2 Hrs.**

Begin your 5G journey by learning about the foundations of wireless and cellular communications. In this module, we focus on the core principles of wireless communication and how key wireless technologies give us the mobile experience to which we are accustomed. This module will also give you the basis you need to dive into and understand the key technological components on which 5G is built.

Unit-II **Overview of the 5G NR vision.** **2 Hrs.**

Now that we've covered the basics of wireless communication, let's discuss what 5G is and why it is important. In this module, we talk about the key technological drivers of 5G and what 5G is capable of.

Unit-III **Introduction to 5G networks and features.** **2 Hrs.**

In this module, we dive into the wireless technologies that make 5G possible and learn how the different technologies interact to give us a 5G experience. After completing this module, you will have a greater understanding of key 5G technologies and features such as mmWave, Massive MIMO, Network Slicing, Mobile Edge Computing, and more.

Unit-IV **Discuss 5G spectrum and mmWave.** **2 Hrs.**

Millimeter Wave (mmWave) is a key aspect of 5G, so it is important to understand how 5G works in the mmWave spectrum and why mmWave is necessary for an optimal 5G experience. In this module, we discuss the 5G spectrum, 5G mmWave, and how mmWave can be deployed in a variety of scenarios in both indoor and outdoor environments. We also learn from several case studies of real-life mmWave deployments and their realistic performance advantages.

Unit-V **Learn about Massive MIMO and its impact on wireless technology.** **1 Hrs.**

In this module, we discuss the importance of Massive MIMO and how it fits into the 5G landscape. We'll talk about what Massive MIMO is, what it enables, and why it is necessary for 5G. We conclude this module by learning more from case studies of real-life Massive MIMO deployments.

Unit-VI **Evolution of the 5G radio access network (RAN).** **1 Hrs.**

In this module, we dive into the Radio Access Network (RAN) and what it looks like in the world of 5G. We discuss the evolution of RAN technology and how this evolution has led to 5G. We also talk about the key benefits we experience as companies and consumers as a result of the RAN evolution.

Unit-VII **5G private networks and industrial IoT.** **1 Hrs.**

5G private networks and Industrial IoT are becoming increasingly popular in the business world, as companies are beginning to understand their benefits and potential. In this module, we dive into 5G private networks, their architecture, their benefits for industrial IoT, and how they are changing the way businesses operate and communicate.

Unit-VIII **Overview of 5G security.** **1 Hrs.**

As we continue to move more of our personal and professional lives online, digital security is crucial. In this module, we study 5G's approach toward data and network security and how 5G can enhance your personal and professional privacy.

Course 2: AI Foundations & Industry Overview for Telecommunication

COURSE CONTENTS

Unit-I **Overview** **2 Hrs.**

This module introduces the overall certification structure and explains how the learning experience is organized throughout the course. To support different learning preferences, the content is offered in multiple formats, including Videos, eBooks, Audiobooks, and Podcasts. Each format covers the same key concepts, giving you the flexibility to learn in the way that works best for you. You can choose any format based on your preferred learning style and move through the course at your own pace.

Unit-II **Data Engineering and Telecom Data Analytics** **2 Hrs.**

- Data Engineering and Telecom Data
- Processing structured vs. unstructured data
- Designing and Managing the Telecom Data Pipeline
- Data Engineering tools and Technology
- Case Study: SK Telecom's Big Data Analytics with Metatron Discovery

Unit-III **AI For Network Security** **6 Hrs.**

- Introduction to 5G
- AI Applications in 5G
- Enhancing Network Management Sharing, AI
- Case Study: SK Telecom—AI-Powered QoE Optimization for Real-Time Gaming and Streaming in 5G Networks
- Predictive Network Management
- Performance Enhancement Techniques
- Traffic Management Strategies
- Case Study: Ericsson—Enhancing Network Performance with AI-Driven Load Balancing
- Security Threats in Telecom
- AI Security Solutions
- Advanced Security Frameworks
- Case Study: AI-Based Fraud Detection in Telecom