



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

Third Year B. Tech

Batch: 2023-2027

With Effect from Academic Year 2025-2026



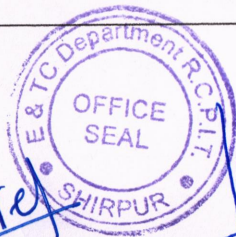
Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405

www.rcpit.ac.in

Semester-V-NEP (w.e.f. Academic Year 2025-2026)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	Total Credit
				L	T	P	Continuous Assessment				ESE			
							TA	TT1	TT2	Average				
										TT1&TT2				
1	PC	RCP23ECPC501	Digital Signal Processing	3	-	-	25	15	15	15	60	100	3	4
2	PC	RCP23ELPC501	Digital Signal Processing Laboratory	-	-	2	25	-	-	-	25	50	1	
3	PC	RCP23ECPC502	Wave Theory & Radio Frequency Design	3	-	-	25	15	15	15	60	100	3	4
4	PC	RCP23ELPC502	Wave Theory & Radio Frequency Design	-	-	2	25	-	-	-	25	50	1	
5	PC	RCP23ECPC503	Analog & Digital Communication	3	-	-	25	15	15	15	60	100	3	4
6	PC	RCP23ELPC503	Analog & Digital Communication	-	-	2	25	-	-	-	25	50	1	
7	PE#	RCP23ECPE501	Radar Engineering	3	-	-	25	15	15	15	60	100	3	4
		RCP23ELPE501	Radar Engineering Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE502	Computer Organization & Architecture	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE502	Computer Organization & Architecture Lab	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE503	Control Systems	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE503	Control Systems Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE504	Linear Algebra	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE504	Linear Algebra Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE505	Advanced Microcontroller	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE505	Advanced Microcontroller Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE506	Neural Network & Fuzzy Logic	3	-	-	25	15	15	15	60	100	3	
RCP23ELPE506	Neural Network & Fuzzy Logic Laboratory	-	-	2	25	-	-	-	25	50	1			
8	MD	RCP23ECMD501	Database Management System	2	--	--	25	15	15	15	60	100	2	2
9	MD	RCP23ELMD501	Database Management System Laboratory	--	--	2	25	--	--	--	25	50	1	1
10	HS	RCP23ITHSX06	Environmental Science Tutorial	--	1	--	25	--	--	--	--	25	1	1
11	SC	RCP23IPSC501	Semester Project-III	--	--	2	25	--	--	--	25	50	1	1
Total				14	2	12	325	75	75	75	425	825	21	21

Any One Elective



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Semester-VI-NEP (w.e.f. Academic Year 2025-2026)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	Total Credit
				L	T	P	Continuous Assessment				ESE			
							TA	TT1	TT2	Average				
										TT1&TT2				
A	B	C	A+B+C											
1	PC	RCP23ECPC601	Computer Networks	3	-	-	25	15	15	15	60	100	3	4
2	PC	RCP23ELPC601	Computer Networks Laboratory	-	-	2	25	-	-	-	25	50	1	
3	PC	RCP23ECPC602	Image Processing	3	-	-	25	15	15	15	60	100	3	4
4	PC	RCP23ELPC602	Image Processing Laboratory	-	-	2	25	-	-	-	25	50	1	
5	PC	RCP23ECPC603	Radiating System	3	-	-	25	15	15	15	60	100	3	4
6	PC	RCP23ELPC603	Radiating System Laboratory	-	-	2	25	-	-	-	25	50	1	
7	PE#	RCP23ECPE601	Power Electronics	3	-	-	25	15	15	15	60	100	3	4
		RCP23ELPE601	Power Electronics Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE602	Digital VLSI Design	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE602	Digital VLSI Design Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE603	Operating Systems	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE603	Operating Systems Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE604	Big Data Analytics	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE604	Big Data Analytics Laboratory	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE605	Data Compression & Encryption	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE605	Data Compression & Encryption Lab	-	-	2	25	-	-	-	25	50	1	
		RCP23ECPE606	Data Analytics	3	-	-	25	15	15	15	60	100	3	
		RCP23ELPE606	Data Analytics Laboratory	-	-	2	25	-	-	-	25	50	1	
RCP23ECPE607	Basics of IOT	3	-	-	25	15	15	15	60	100	3			
RCP23ELPE607	Basics of IOT Laboratory	-	-	2	25	-	-	-	25	50	1			
8	MD	RCP23ECMD601	Machine Learning & Applications	3	0	0	25	15	15	15	60	100	3	4
9	MD	RCP23ELMD601	Machine Learning & Applications Lab	0	0	2	25	-	-	-	25	50	1	
10	EL	RCP23IPEL601	Project Stage-I	0	0	4	50	-	-	-	50	100	2	2
11	HS	RCP23ICHSX07	Constitution of India	1	0	0	Audit	-	-	-	Audit	Audit	Audit	Audit
Total				16	0	14	300	75	75	75	475	850	22	22

Any One Elective



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Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Digital Signal Processing (RCP23ECPC501)	
Digital Signal Processing Laboratory (RCP23ELPC501)	

Pre-requisite:

- Signals and Systems
- Engineering Mathematics-III

Course Objectives:

- To develop a thorough understanding of DFT and FFT and their applications.
- To teach the design techniques and performance analysis of digital filters.
- To introduce the students to digital signal processors and its applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement DFT and FFT algorithms in finding the response of the system.	L4	Analyze
CO2	Design different types of IIR filters.	L6	Create
CO3	Design different types of FIR filters.	L6	Create
CO4	Evaluate the effects of Poles and Zeros in design of digital filters.	L5	Evaluate

Digital Signal Processing (RCP23ECPC501)

COURSE CONTENTS

Unit-I	Discrete Fourier Transform & Fast Fourier Transform	10 Hrs.
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Definition and Properties of DFT, IDFT, Linear and Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT, Frequency Analysis of Signals Using the DFT, Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, Composite Radix FFT $N=2.3$, $N=3.2$.

Unit-II	Analysis of Linear Time Invariant System	8 Hrs.
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Ideal Filter Characteristics, Position of Poles and Zeros for Low Pass, High Pass, Band Pass, Band Stop, All pass filters, Effect of Poles and Zeros on the Frequency Response, Digital Resonators, Notch Filters, Comb Filters, All-Pass Filters, Digital Sinusoidal Oscillators, Minimum-Phase, Maximum-Phase, and Mixed-Phase Systems

Unit-III	FIR Digital Filters and realization	8 Hrs.
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Characteristics of FIR digital filters, Design of Symmetric and Antisymmetric FIR Filters (Type 1 to Type 4) and its realization, Design of Linear Phase FIR filters using Window techniques (Rectangular, Bartlett, Hamming, Hanning, Blackman), Design of Linear Phase FIR filters using Frequency Sampling technique. FIR filter realization: Direct Form, Cascade and frequency sampling realization.

Unit-IV	IIR Digital Filters and realization	10 Hrs.
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Mapping of S-plane to Z-plane using impulse invariance method (IIM) and bilinear transformation method (BLT), Conversion of analog filter to digital filter, Analog filter approximations: Butterworth, Chebyshev I, Types of IIR filter (Butterworth, Chebyshev-I, Chebyshev-II, Elliptical), Design of IIR digital filters (Butterworth and Chebyshev-I), Frequency Transformations, Compare FIR and IIR filter, IIR filter realization: Direct Form, Cascade and Parallel Form.

Unit-V	Finite word length effect on FIR and IIR filter performance	6 Hrs.
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Errors Resulting from Rounding and Truncation, Analysis of Sensitivity to Quantization of Filter Coefficients, Quantization of Coefficients in FIR Filters, Output noise power from a digital system, Product quantization, Noise model for direct form and cascaded IIR structure (first order), Coefficient quantization error and zero input limit cycle, Limit-Cycle Oscillations in Recursive Systems, Scaling to Prevent Overflow

Digital Signal Processing Laboratory (RCP23ELPC501)

List of Laboratory Experiments: (Any Eight)

1. To determine linear and circular convolution using DFT/FFT.
2. To perform Overlap-Add/Overlap-Save methods for long data sequence using DFT/FFT.
3. To find the effect of poles and zeros on FIR/IIR filters (Frequency response).
4. To design linear phase filters and plot magnitude and phase responses.
5. To Design a FIR filter by window method.
6. To Design a FIR filter by frequency sampling method
7. To design Butterworth and Chebyshev-I IIR filters.
8. To perform basic signal processing operations with DSP processor (fixed point/Floating point).
9. To Generate elementary signal (Sine/Cosine) and find its frequency response using DSP processor (fixed point/Floating point).
10. To implement a system for Real time signal filtering by DSP Processor.
11. To design a FIR/IIR filter to remove a noise (sine wave with a given frequency) corrupting ECG/Speech signal.
12. To measure the effect of finite word length on FIR/IIR filter performance.
13. To realize FIR and IIR Filters using Direct Form, Cascade/Parallel form structures.
14. To simulate a system for signal analysis or synthesis.
15. To implement a discrete time system for signal processing using DSP Processor.

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. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing," Pearson Education, Fourth Edition, 2007.
2. S. Salivahan, C. Gnanapriya, "Digital Signal Processing," McGraw Hill Education (India), Fourth Edition, 2015.
3. B. Venkata Ramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications," Tata McGraw Hill, Second Edition, 2004.

Reference Books

1. Alan V. Oppenheim, Ronald W. Schaffer, "Discrete Time Signal Processing," Pearson Education, Third Edition, 2021.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach," McGraw

Hill Education, Fourth Edition, 2013.

3. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing - A Practical Approach,” Pearson Education, Second Edition, 2001
4. Monson H. Hayes, “Digital Signal Processing” Schaum’s Outline Series, Second Edition, 2011

NPTEL / Swayam Course:

1. Course: Digital Signal Processing by Prof. S. C. Dutta Roy, IIT Delhi
<http://www.nptelvideos.in/2012/12/digital-signal-processing.html>
2. Course: Digital Signal Processing by Prof. V. M. Gadre, IIT Bombay
<https://nptel.ac.in/courses/108/101/108101174/>
3. Course: Digital Signal Processing by Prof. T. K. Basu, IIT Kharagpur
<https://nptel.ac.in/courses/108/105/108105055/>

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Wave Theory & Radio Frequency Design (RCP23ECPC502)	
Wave Theory & Radio Frequency Design Laboratory (RCP23ELPC502)	

Prerequisite:

- Mathematics for Telecommunication Engineering
- Electrical Network.

Course Objectives:

- To learn concept of static and time varying electromagnetic fields.
- To solve problems related to EM fields using Vectors and Partial differential equations.
- To learn Electromagnetic radiation and propagation in space and within transmission lines.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Compute electric and magnetic fields for symmetrical charge and current configurations using basic static and time varying principles of electromagnetics.	L3	Apply
CO2	Explain the basic concept of S matrix and ABCD matrix in network analysis.	L2	Understand
CO3	Explain the behaviour of Inductor, Capacitor and Resistor at high frequency	L2	Understand
CO4	Calculate various parameters of transmission line analytically and using Smith Chart.	L4	Analyze
CO5	Develop passive RF filter configurations for given specifications.	L5	Evaluate

Impedance Transformation: Impedance Transformation for General Load, Standing Wave Ratio, Special Transformation Conditions.

Unit-VI

RF Filter Design

8 Hrs.

RF Filter Design: Basic Resonator and Filter configurations

Filter Types and Parameters, Low-Pass Filter, High-Pass Filter, Bandpass and Band stop Filters, Insertion Loss.

Filter Design by the Image Parameter Method: Image Impedances and Transfer Functions for Two-Port Networks, Constant-k Filter sections, m- derived Filter Sections, Composite Filters.

Special Filter Realizations using Insertion Loss Method: Butterworth-Type Filters, Chebyshev-Type Filters, Denormalization of Standard Low-Pass Design.

Filter Implementation: Unit Elements, Kuroda's Identities, Microstrip Filter Design.

Wave Theory & Radio Frequency Design Laboratory (RCP23ELPC502)

List of Laboratory Experiments :(Any 8)

1. Numericals on Electrostatics & Electric Boundary conditions
2. Numericals on Magnetostatics
3. Numericals on Time varying fields and Maxwell Equations
4. Numericals on Wave Propagation in different material
5. Numericals on network parameters and properties
6. Characterization of R/L/C at high frequency
7. Transmission line impedance calculations Analytical and Smith chart
8. Transmission line reflection coefficient calculations Analytical and Smith chart
9. Filter Design by the Image Parameter Method
10. Filter Design by the Insertion Loss Method

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Text Books

1. William H. Hayt and John A Buck, "Engineering Electromagnetics", Tata McGraw-Hill Publishing Company Limited, 9th Edition, 2020.
2. Ludwig, Reinhold & Bretchko, Pavel, "RF circuit design: Theory and applications, Prentice- Hall, 2nd Edition, Upper Saddle River, N.J, 2011.

Reference Books

1. Matthew N. O. Sadiku, S. V. Kulkarni, "Principles of electromagnetics", Oxford University Press, 6th Edition, 2015.
2. Pozar, David M, "Microwave Engineering", Hoboken, NJ: Wiley Publication, 2012.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Analog and Digital Communication (RCP23ECPC503)	
Analog and Digital Communication Laboratory (RCP23ELPC503)	

Pre-requisite:

- Signals and Systems

Course Objectives:

- To Learn various Analog and Digital Communication Systems.
- To equip students with the knowledge and skills to design, analyse, and implement efficient source and error coding techniques for data compression, error detection, and correction, enabling reliable and optimized communication across various digital systems.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze Analog Communication techniques and reception	L4	Analyze
CO2	Describe pulse communication and pulse code modulation systems	L2	Understand
CO3	Demonstrate and compare various digital modulation techniques	L3	Apply
CO4	Design and implement source and error control coding scheme.	L5	Evaluate

Analog and Digital Communication Laboratory (RCP23ELPC503)

List of Laboratory Experiments: (Any 8)

1. Study of Amplitude Modulation.
2. Study of Double Side Band Suppressed Carrier and Single Side Band Amplitude Modulation
3. Simulate of AM system and generate time and frequency domain output.
4. To study different types of frequency modulators and Demodulators.
5. Simulate Frequency Modulation system and generate time and frequency domain output.
6. Implement Pre-emphasis and De-emphasis circuit required for FM and analyze the output.
7. Study of Natural Sampling and its reconstruction.
8. Study of Flat top sampling and its reconstruction.
9. Study of Pulse Amplitude Modulation.
10. Study of Pulse Width Modulation.
11. Study of Pulse Position Modulation.
12. Study of PAM-TDM system.
13. Entropy and Mutual Information
14. Source Coding Algorithms (Huffman coding)
15. Linear block codes (Error detection and correction)
16. Cyclic codes (comparison of performance of coded and un-coded system)
17. Convolutional Encoding.
18. ASK, FSK and PSK
19. Generation and Detection of Binary Amplitude Shift Keying (BASK)
20. Generation of Binary FSK signal modulation (FSK)

Text Books

1. T. L. Singal, "Analog and Digital Communications", Tata Mc-Graw Hill, 2014.
2. Kennedy, Davis, "Electronics Communication Systems", TMH, 4th Edition, 2012.

Reference Books

1. Toub Schilling and Shaha, "Principles of Communication Systems", Tata McGraw Hill, 4th Edition, 2016.
2. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and applications", Pearson, Dorling Kindersley (India), Delhi, 2nd Edition, 2009.
3. P Ramakrishna Rao, "Digital Communication", Tata Mc-Graw Hill, New Delhi, 1st Edition.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Radar Engineering (RCP23ECPE501)	
Radar Engineering Laboratory (RCP23ELPE501)	

Pre-requisite:

- Electromagnetic Field Theory
- Analog Communication

Course Objectives:

- To interpret Radar equations
- To understand various types of Radar.
- To identify various devices used in Radar transmitter and receiver.
- To design Radar transmitter and receiver for given conditions.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain generalized concepts of radar and its applications.	L2	Understand
CO2	Analyze radar range equations in various conditions.	L4	Analyze
CO3	Describe different types of radar for specific application.	L2	Understand
CO4	Explain concept of tracking radar.	L2	Understand
CO5	Evaluate the design constraints for transmitter and receiver	L5	Evaluate

Radar Engineering (RCP23ECPE501)

COURSE CONTENTS

Unit-I Introduction to Radar 8 Hrs.

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

Unit-II Radar Range Equation 8 Hrs.

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

Unit-III MTI and Pulse Doppler Radar 10 Hrs.

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

Unit-IV Tracking Radar 8 Hrs.

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

Unit-V Radar Transmitter and Receiver 8 Hrs.

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

Radar Engineering Laboratory (RCP23ELPE501)

List of Laboratory Experiments: (Any Eight)

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

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. Merrill Skolnik, Introduction to Radar Systems, 2nd Edn, Tata McGra Hill.
2. G S N Raju, Radar Engineering, 1st Edn, Wiley Publication.

Reference Books

1. E. David Jansing, "Introduction to Synthetic Aperture Radar", McGraw Hill, 2nd Edition, 2021.
2. Clive Alabaster," Pulse Doppler Radar", SciTech Publishing, 2nd Edition, 2012.
3. William L Melvin, James A Scheer, "Principles of Modern Radar", SciTech Publishing, 1st Edition, 2014.
4. Bassem R. Mahafza, "Radar Signal Analysis", CRC press, 1st Edition, 2021.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Computer Organization and Architecture (RCP23ECPE502)	
Computer Organization and Architecture Laboratory (RCP23ELPE502)	

Pre-requisite:

- Digital System Design

Course Objectives:

- To conceptualize the basics of organizational and architectural issues of a digital Computer
- To analyse performance issues in processor and memory design of a digital Computer.
- To understand various data transfer techniques in digital computer
- To analyse processor performance improvement using instruction level parallelism

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basic concepts and structure of computers and functionality of the central processing unit.	L2	Understand
CO2	Implement computer arithmetic operations.	L3	Apply
CO3	Describe the basics of instruction sets and their impact on programming.	L2	Understand
CO4	Explain the concepts of memory and I/O organization.	L2	Understand

Computer Organization and Architecture (RCP23ECPE502)

COURSE CONTENTS

Unit-I Introduction of Computer Organization and Architecture 4 Hrs.

Basic organization of computer, Evolution of Computers, Von Neumann model. Performance measure of Computer Architecture. The Evolution of the Intel 8086 Architecture, Embedded Systems and the ARM.

Unit-II Data Representation and Arithmetic Algorithms 8 Hrs.

Number representation: Binary Data representation, two's complement representation and Floating-point representation. Integer Data arithmetic: Addition, Subtraction. Multiplication: Unsigned Signed multiplication- Add Shift Method, Booth's algorithm. Division of integers: Restoring and non-restoring division, signed division, Basics of floating-point representation IEEE 754 floating point (Single double precision) number representation. Floating point arithmetic: Addition, subtraction.

Unit-III Control Unit 6 Hrs.

Soft wired (Micro programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations. Introduction to RISC and CISC architectures and design issues. Introduction to Concepts of multiprocessors.

Unit-IV Instruction Sets: Characteristics and Functions 12 Hrs.

Machine Instruction Characteristics, Types of Operands, Intel 8086 and ARM Data Types, Types of Operations, Intel 8086 and ARM Operation Types. Instruction Sets: Addressing Modes and Formats: Addressing, 8086 and ARM Addressing Modes, Instruction Formats, 8086 and ARM Instruction Formats, Assembly Language, Instruction cycle, Instruction Pipelining, For 8086, The ARM Processor Instruction-Level Parallelism and Superscalar Processors: Design Issues, Flynn's classifications, Pipeline processing.

Unit-V Memory Organization 8 Hrs.

Introduction to Memory and Memory parameters. Classifications of primary and Secondary memories. Types of RAM and ROM, Allocation policies, Memory Hierarchy and characteristics. Cache memory: Concept, architecture (L1, L2, L3), Mapping techniques. Cache Coherency, Interleaved and Associative memory.

Unit-V I/O Organization 4 Hrs.

Input/output systems, I/O modules and IO processors. Types of data transfer Techniques: Programmed I/O, Interrupt driven I/O and DMA.

Computer Organization and Architecture Laboratory (RCP23ELPE502)

List of Laboratory Experiments: (Any 8)

1. To study Full Adder (7483).
2. To study ALU (74181).
3. To study MASM (Micro Assembler).
4. A program for hexadecimal addition and multiplication.
5. A program for binary multiplication.
6. A program for Hamming code generation, detection and correction.
7. A program for Booth's multiplication
8. A program for LRU page replacement algorithm
9. A program for FIFO page replacement algorithm
10. A program to simulate the mapping techniques of Cache memory.
11. Direct Mapped cache.
12. Associative Mapped cache

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. William Stallings, Computer Organization and Architecture: Designing for Performance, 8th Edition, Pearson Publication, 2019.
2. Douglas V. Hall, Microprocessors and Interfacing, 2nd Edition, Tata McGraw-Hill, 2006.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, Computer Organization and Embedded Systems, 6th Edition, McGraw-Hill, 2022.

Reference Books

1. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill, 2017.
2. John P. Hayes, "Computer Architecture and Organization", Third Edition, McGraw-Hill, 1997.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Control Systems (RCP23ECPE503)	
Control Systems Laboratory (RCP23ELPE503)	

Pre-requisite:

- Basic Electrical Engineering & Digital Electronics
- Engineering Mathematics-I
- Engineering Mathematics-II
- Signal and Systems

Course Objectives:

- To provide fundamental concept of control systems.
- To introduce mathematical modelling, time domain analysis & frequency domain analysis.
- To develop concepts of stability and its assessment criteria of the system.
- To study basic concepts of controllers.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basic concepts of control system	L2	Understand
CO2	Derive the mathematical model of different type of the systems.	L3	Apply
CO3	Analysis of systems in time and frequency domain	L4	Analyze
CO4	Analyze and Find stability of given system using appropriate criteria	L4	Analyze
CO5	Apply the control theory to design the conventional controllers widely used in the industries.	L3	Apply

Control Systems Laboratory (22PEET6052L)

List of Laboratory Experiments: (Any Eight)

1. To verify the effect of zero and pole to the second order closed loop control system.
2. To find static errors for type 0, type 1, type 2 Control System.
3. To plot frequency response of a 1st order and 2nd order control systems.
4. To find transfer function of a 1st order and 2nd order control systems.
5. To verify the effect of Zero and pole to open loop transfer function of a second order.
6. To find controllability & observability of the given control system.
7. To design root locus for given control system.
8. To design Bode plot for first and second order control system.
9. Verification of observability and controllability for given control system.
10. To design Nyquist plot for given control system.
11. To find Transfer functions of P, PI, and PID controller.

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. I. J. Nagrath, MadanGopal, Control System Engineering, New Age International Publication, Seventh Edition, 2021.
2. K. Ogata, Modern Control Engineering, Pearson Education, Fifth Edition, 2015.

Reference Books

1. Madan Gopal, Control Systems Principles and Design, Tata McGraw hill, 7th Edition, 2012.
2. Ajit K. Mandal, Introduction to Control Engineering: Modelling, Analysis and Design, New Age International Publication, 2nd Edition, 2010.
3. S. Hasan Saeed, Automatic Control System, S.K. Kataria & Sons, 9th Edition, 2017.
4. Normon S. Nise, Control System Engineering, John Wiley & sons, 8th Edition, 2020.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Linear Algebra (RCP23ECPE504)	
Linear Algebra Laboratory (RCP23ELPE504)	

Pre-requisite:

- Mathematics for Telecommunication Engineering

Course Objectives:

- Understanding basic concepts of linear algebra to illustrate its power and utility through applications.
- Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in Engineering.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the abstract concepts of matrices and system of linear equations using decomposition Methods.	L2	Understand
CO2	Demonstrate the basic notion of vector spaces and subspaces.	L3	Apply
CO3	Apply the concept of vector spaces using linear transforms and inner product spaces applications in cryptography.	L3	Apply

Linear Algebra (RCP23ECPE504)

COURSE CONTENTS

Unit-I **System of Linear Equations** **6 Hrs.**

Gaussian elimination and Gauss Jordan method Elementary matrices Permutation matrix inverse matrices System of linear equations LU factorizations.

Unit-II **Vector Spaces** **12 Hrs.**

The Euclidean space and vector space, subspace linear combination, span-linearly dependent-independent bases, dimensions, finite dimensional vector space, The four fundamental spaces, Rank and nullity Bases for subspace.

Unit-III **Linear Transformations** **10 Hrs.**

Linear transformations, Basic properties, invertible linear transformation, matrices of linear transformations, vector space of linear transformations, change of bases

Unit-IV **Product Spaces and Applications** **8 Hrs.**

Dot products and inner products, the lengths and angles of vectors, matrix representations of inner products, Gram-Schmidt Orthogonalization, QR factorization- Projection - orthogonal projections

Unit-V **Applications** **6 Hrs.**

An Introduction to coding - Classical Cryptosystems Plain Text, Cipher Text, Encryption.

Linear Algebra Laboratory/Tutorial (22PEET6057L)

List of Tutorial: (Any Eight)

1. Gaussian elimination and Gauss Jordan Method
2. LU Factorizations.
3. The Four Fundamental Spaces.
4. Linear Transformations.
5. Gram-Schmidt Orthogonalization.
6. QR Factorization.
7. Linear Dependence and Independence.
8. Least Squares Approximation.
9. Case Study: Classical Cryptosystems.
10. Gaussian elimination and Gauss Jordan method.

Text Books

1. Jin Ho Kwak and Sungpyo Hong, Linear Algebra, Springer, Second Edition, 2004.
2. Bernard Kolman and David, R., Introductory Linear Algebra- An applied first course, Pearson Education, Ninth Edition, 2011.

Reference Books

1. Stephen Andrilli and David Hecker, Elementary Linear Algebra, Academic Press, Fifth Edition, 2016.
2. Rudolf Lidl and Guter Pilz, Applied Abstract Algebra, Springer, Second Edition, 2004.
3. Howard Anton, Robert C Busby, Contemporary linear algebra, Wiley, First Edition, 2003.
4. Gilbert Strang, Introduction to Linear Algebra, Cengage Learning, Fifth Edition, 2015.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Advanced Microcontroller (RCP23ECPE505)	
Advanced Microcontroller Laboratory (RCP23ELPE505)	

Pre-requisite:

- Digital System Design
- Microcontroller & Applications- I

Course Objectives:

- To provide an in-depth understanding of the ARM Cortex-M architecture, focusing on the STM32F401RE microcontroller.
- To equip students with the skills to program and debug advanced microcontrollers.
- To enable the design and implementation of real-world embedded systems using STM32F401RE.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the architecture and functionality of the ARM Cortex-M family.	L2	Understand
CO2	Describe the architecture and functionality of the STM32F401RE microcontroller.	L2	Understand
CO3	Develop the programs for peripherals, sensors and actuators.	L6	Create
CO4	Design and implement microcontroller-based systems for real world applications	L6	Create

Advanced Microcontroller Laboratory (RCP23ELPE505)

List of Laboratory Experiments: (Any Eight)

1. Setting up STM32 IDE and writing a basic LED blinking program.
2. Interfacing an LED and Push-Button with GPIO Input and Output Operations.
3. Implementing Push-Button Controlled LED Toggle Using External Interrupt.
4. Implementing LED Blinking Using Delay Generation with General-Purpose Timers.
5. Interfacing and Speed Control of a DC Motor Using PWM.
6. Timer-based PWM generation for LED brightness control.
7. FADC-based temperature sensor interfacing.
8. UART communication for data transmission and reception.
9. Interfacing and Reading Sensor Data from MPU6050 using I2C Communication.
10. Interface an SPI device, such as an EEPROM, and perform read/write operations.
11. Interfacing STM32F401RE with a Wi-Fi module (ESP8266/ESP32).

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Text Books

1. Joseph Yiu, “The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors”, Newnes Publications, 3rd Edition, 2013.
2. Indranil Sengupta and Kamalika Dutta, “Embedded System Design with ARM”, NPTEL course book.
3. Muhammad Ali Mazidi, Shujen Chen, and Sepehr Naimi, “Microcontroller Programming and Interfacing with ARM Cortex-M Processor”, MicroDigitalEd, 1st Edition, 2017.

Reference Books

1. STM32F401RE Reference Manual and Datasheet.
2. Donald Norris, “Programming with STM32: Getting Started with the Nucleo Board and C/C++”, McGraw-Hill Education, 1st Edition, 2018.
3. Carmine Noviello, Mastering STM32, Leanpub, 1st Edition, 2018.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Neural Network and Fuzzy Logic (RCP23EPE506)	
Neural Network and Fuzzy Logic Laboratory (RCP23ELPE506)	

Pre-requisite:

- Mathematics for Telecommunication Engineering

Course Objectives:

- To introduce the concepts and understanding of artificial neural networks and fuzzy logic.
- To introduce neural network design concepts.
- To expose neural networks-based methods to solve real world complex problems.
- To provide knowledge of fuzzy logic to design the real-world fuzzy systems.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain training of Neural Networks using various training rules with consideration of different parameters like overfitting, under fitting.	L2	Understand
CO2	Calculate and update the weights of the neural networks to specify the working and applications of different types of neural networks.	L3	Apply
CO3	Design fuzzy sets for various applications and solve fuzzy set theory problems.	L6	Create
CO4	Design various engineering application using Neural Networks/ Fuzzy Logic.	L6	Create

Neural Network and Fuzzy Logic Laboratory (RCP23ELPE506)

List of Laboratory Experiments: (Any Eight)

1. Fuzzy Set Operations: AND, OR, D-Morgan's theorem
2. (a) Simulation of Mamdani Fuzzy Inference System for washing machine control
(b) Summary of research paper based on Fuzzy logic
3. Simulation of Sugeno Fuzzy Inference System for given application
4. Simulation of Mamdani Fuzzy Inference System for image processing application. (Edge detection)
5. Write a program for perceptron training algorithm and test it for two input AND OR gate function
6. Write a program for training and testing of Multilayer Perceptron for two input EX-OR gate
7. Write a program for training and testing of Multilayer Perceptron for character recognition application
8. Program for Radial basis neural network for interpolation application
9. Write a program for training and testing of RBF for pattern classification application
10. Kohonen Self Organising map for image classification
11. To Study the use of Microsoft Machine Learning Studio (classic) in Neural Network and Machine Learning

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. S. N. Sivanandam and S. N. Deepa, Introduction to Soft computing, Wiley India Publications, Third Edition, 2018.
2. S. Rajasekaran, G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications, Second Edition, 2017.

Reference Books

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India Publications, 3rd Edition, 2010.
2. J. S. R. Jang, C.T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice hall Learning India, 1997
3. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, "Introduction to Neural Network Using Matlab", Tata McGraw-Hill Publications, 2006

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Database Management System(RCP23ECMD501)	
Database Management System Laboratory(RCP23ELMD501)	

Prerequisite:

- Structured Programming using C
- Object Oriented Programming using Java

Course Objectives:

- Learn and practice data modelling using the entity relationship and developing database designs.
- Understand the use of Structured Query Language (SQL) and learn SQL syntax.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamental concepts of databases, including design, architecture, and data models.	L2	Understand
CO2	Design E-R diagrams, convert to relational schema and use relational algebra queries.	L6	Create
CO3	Construct SQL queries to perform operations on the database.	L3	Apply
CO4	Explain transaction management techniques.	L2	Understand

Database Management System(RCP23ECMD501)

COURSE CONTENTS

Unit-I Introduction to Databases and Data models 6 Hrs.

Introduction, Characteristics of databases, File system vs. database system, Users of the database system, Schema and Instance, Data Independence, level of abstraction, DBMS system architecture, The importance of data models , Types of data models.

Unit-II Relational Data Model 8 Hrs.

Entity–Relationship Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation.

Relational Model: Introduction to the Relational Model, relational schema and concept of keys, Mapping the ER Model to the Relational Model Relational Algebra: Unary and Set operations, Relational Algebra Queries.

Unit-III Structured Query Language (SQL) and Normalization 8 Hrs.

SQL: Basic concepts, state variable and state models for electrical systems, general state space representation, conversion between state space and transfer function, concept of state transition matrix, properties of state transition matrix, controllability and observability, analysis of LTI systems, with Examples.

Normalization: Concept of normalization, Function Dependencies, Normal Forms- 1NF, 2NF, 3NF, BCNF.

Unit-IV Transaction management Concurrency control 6 Hrs.

Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management

Database Management System Laboratory (RCP23ELMD501)

List of Laboratory Experiments:

1. Output all the data entered in the table
2. Create a table from the given data
3. Insert Data into the table
4. Add a column to the table and set default values
5. Update the data in the given row(s) of the given table
6. Delete all rows in the table
7. Create a table with the given constraints
8. Use a select query to fetch data
9. Use distinct queries to fetch unique data
10. Use the where clause to obtain information that meets specific conditions
11. Use the BETWEEN clause along with WHERE to filter the table based on 2 values
12. Use the AND clause with WHERE to filter the table based on 2 separate conditions
13. Use the OR clause is used along with WHERE to filter the table that meets any one of the given multiple conditions.
14. Use the LIKE operator along with WHERE to filter similar values.
15. Use of additional queries - IS NULL, ORDER BY LIMIT
16. Renaming of columns during output
17. Use the MAX () and MIN () functions to retrieve the maximum and minimum values from a column
18. Combining table - Joins two tables and outputs a single table
19. Use a left join to output data
20. Use a cross join to output the data
21. Use UNION to place a table right on top of another table.
22. Use the WITH query to create temporary tables
23. Use the EXCEPT query to output the data
24. Use the INTERSECT query to output the data
25. Execute a non-correlated subquery independently of the outer query

Text Books

1. A. Silberschatz, H. Korth, S. Sudarshan, Database System and Concepts, McGraw Hill, 7th Edition, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database System, 7th Edition, 2017.

Reference Books

1. Peter Rob, Carlos Coronel, Database Systems Design, Implementation and Management, 8th Edition, 2007.
2. Lynn Beighley, Head First SQL, O'Reilly Media, 1st Edition, 2007.
3. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw- Hill, 3rd Edition, 2014.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Environmental Science Tutorial (RCP23ITHSX06)	

Course Objectives:

- Understand environmental issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
- Familiarise environment related legislation

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe how human activities affect the environment.	L2	Understand
CO2	Describe the various technology options that can make a positive environmental difference.	L2	Understand

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-V
Semester Project- III (RCP23IPSC501)	

Course Objectives:

- To determine the goals, resource requirements of project and produce them in the form of documentation.
- To learn effective utilization of time and project management skills.
- To address the real-world projects, to connect theory with practice as per recent industrial trends.
- To integrate knowledge and skills from various areas through more complex and multidisciplinary projects.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project- III (RCP23IPSC501)

COURSE CONTENTS

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' documentation and technical skills to find the cost-effective solution. Guidelines are as follows:

- Project group: 4 to 6 students (including 2/3 second year and 2/3 third year).
- Each group will be allotted a final year mentor and a faculty guide.
- Groups submit three topic preferences; one is finalized in discussion.
- Identify required hardware and software for the problem statement.
- Two reviews per semester: August and October.
- First review: literature survey, documentation, budgeting.
- Second review: at least 30% project completion.

Assessment Criteria:

- Final submission of report in prescribed format post guide confirmation.
- Evaluation by departmental committee including guide.
- Oral exam by internal and external examiners with presentation/demo.

Prescribed Project Report Format: Minimum 25 pages, including:

- Introduction
- Literature Survey
- Related Theory
- Implementation Details
- Project Outcomes
- Conclusion
- References

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

- Guide will monitor weekly progress and marks allocation will be as per Table 2.

Table 1: Log Book Format

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

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:
- Departmental committee (including project guide) will evaluate project as per Table 3. Each group shall present/publish a paper based on the semester project in reputed/peer reviewed Conference/Journal/TechFest/Magazine/ before the end of the semester.

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

1. Objective and Expected outcome
2. Long term social impact
3. Innovativeness and Motivation
4. Documentation
5. Simulation effectiveness
6. Literature survey and Comparative Methodology
7. Project Progress/Implementation
8. Overall Presentation and Team work

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

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

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Computer Networks (RCP23ECPC601)	
Computer Networks Laboratory (RCP23ELPC601)	

Pre-requisite:

- Analog Communication
- Digital Communication

Course Objectives:

- To learn various hardware network components.
- To understand network reference models and process involved in data communication.
- To understand the protocols working at 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.	L4	Analyze
CO3	Describe responsibilities of the data link layer and explain the data link layer protocols.	L2	Understand
CO4	Design network and subnetwork and use commands for investigation and troubleshooting.	L6	Create
CO5	Analyze transport layer protocols.	L4	Analyze

Computer Networks Laboratory (RCP23ELPC601)

List of Laboratory Experiments: (Any 8)

1. Networking Commands using CISCO Packet Tracer.
2. Hardware and Software Network Components.
3. Web (HTTP and DNS), FTP and SMTP Server Configuration.
4. RIP Protocol.
5. OSPF Protocol.
6. TELNET Configuration using CISCO Packet Tracer.
7. Firewall using standard and extended ACL's.
8. VLSM using CISCO Packet Tracer.
9. Dijkstra's Algorithm.
10. Bellman Ford Algorithm.
11. Network Packet Analysis using Wireshark.
12. Virtual LAN using CISCO Packet Tracer.

Text Books

1. A. S. Tanenbaum, Computer Network, 4th edition, Prentice Hall
2. B. F. Ferouzan, Data and Computer Communication, Tata McGraw Hill.

Reference Books

1. Kurose, Ross, Computer Networking, Addison Wesley
2. W. Richard Stevens, TCP/IP Volume 1, 2, 3, Addison Wesley.
3. D.E.Comer, Computer Networks And Internets, Prentice Hall.
4. B. F.Ferouzan , TCP/IP Protocol Suite, Tata Mc-Graw Hill.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Image Processing (RCP23ECPC602)	
Image Processing Laboratory (RCP23ELPC602)	

Pre-requisite:

- Engineering Mathematics
- Digital Signal Processing (DSP)

Course Objectives:

- To cover the fundamentals, mathematical models and transformation techniques in digital image processing.
- To develop time and frequency domain techniques for image enhancement.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the concepts of sampling, quantization for image acquisition and interpretation	L2	Understand
CO2	Implement various image enhancement algorithms in spatial and frequency domain	L3	Apply
CO3	Apply various filters for image restoration	L3	Apply
CO4	Apply Morphological operations to images to perform image segmentation.	L3	Apply
CO5	Represent images with chain and polygonal codes and describe them with Fourier descriptors.	L2	Understand

Image Processing (RCP23ECPC602)

COURSE CONTENTS

Unit-I	Digital Image Fundamentals	4 Hrs.
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Coordinate representation and Pixel, Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbours of pixel adjacency connectivity, regions and boundaries, Distance measures.

Unit-II	Image Enhancement	12 Hrs.
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Point processing: Image Negative, Thresholding, Gray level slicing with and without background, power law and log transform, Contrast Stretching, Histogram equalization and Histogram Specification Image Enhancement in Spatial Domain (Neighbourhood processing): Basics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering Image Transforms: 1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT, Walsh-Hadamard, Discrete Cosine Transform, Haar Transform, Slant Transform Image Enhancement in Frequency Do- main: The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters.

Unit-III	Image Restoration and Reconstruction	4 Hrs.
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Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering.

Unit-IV	Image Segmentation	12 Hrs.
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edge models, basic and advance edge detection, Edge linking and boundary detection, Canny's edge detection algorithm Thresholding: Foundation, Role of illumination, Basic Global Thresholding, Otsu's method Region Based segmentation: Region Growing, Region Splitting and merging, Relationships between pixels, Hough transform Morphological Image Processing: Overview, Boundary extraction, Region filtering, connected component extraction, Convex hull, thinning; Thickening; skeletons; pruning.

Unit-V	Image Representation and Description	10 Hrs.
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Representation: Chain Codes, Polygonal Approximations Using Minimum-Perimeter Polygons, Signatures Boundary Segments : Skeletons, Boundary Descriptors Some Simple Descriptors Shape Numbers, Fourier Descriptors, Statistical Moments, Regional Descriptors Some Simple Descriptors , Topological Descriptors, , Texture, Moment Invariants.

Image Processing Laboratory (RCP23ELPC602)

List of Laboratory Experiments: (Any 8)

1. To perform basic Image Processing, Geometric, Arithmetic and Logical operations on images.
2. To perform Spatial Domain Image Enhancement using different Point Processing techniques.
3. To perform Spatial Domain Image Enhancement using different Neighborhood Processing techniques.
4. To perform Histogram equalization
5. Application of Harr transform in image processing.
6. To perform frequency domain Image Enhancement techniques.
7. To perform region-based segmentation.
8. To perform morphological operations on Image.
9. To perform edge detection using basic and advanced techniques.
10. To perform Image restoration using various filters.
11. Statistical moments for texture detection

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Text Books

1. Gonzales and Woods, Digital Image Processing, Pearson Education, India, 3rd Edition,
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, Cengage Engineering, 3rd Edition, 2013

Reference Books

1. Anil K. Jain, Fundamentals of Image Processing, Prentice Hall of India, First Edition, 1989.
2. W Pratt, Digital Image Processing, Wiley Publication, 3rd Edition, 2002

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Radiating Systems (RCP23ECPC603)	
Radiating Systems Laboratory (RCP23ELPC603)	

Pre-requisite:

- Electromagnetic Fields & Waves
- Radio Frequency Circuit Design

Course Objectives:

- To learn fundamental parameters of Antenna
- To learn about linear wire antenna elements and Antenna arrays
- To learn about Special types of Antennas
- To learn measurement procedures of Antenna parameters

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain basic antenna parameters like radiation pattern, input impedance, gain and polarization.	L2	Understand
CO2	Derive the field equations for the basic radiating elements like linear wire antenna and loop antenna.	L4	Analyze
CO3	Design of uniform linear and planar antenna arrays using isotropic and directional Sources.	L6	Create
CO4	Design regular shape Microstrip antennas and aperture antennas.	L6	Create

Radiating Systems(RCP23ECPC603)

COURSE CONTENTS

Unit-I	Antenna Fundamentals	10 Hrs.
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Review of Maxwell's equations and vector potential wave equation. Antenna Parameters: Near field and far field radiation, dual equations for electric and magnetic current sources, radiation Mechanism, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, beam width, directivity, Antenna efficiency, Gain, beam efficiency, bandwidth, polarization, input impedance, antenna vector effective length and equivalent areas, antenna radiation efficiency, FRIIS transmission equation.

Measurement of Antenna parameters: Input Impedance, Radiation Pattern, Gain (Two and Three antenna, method), polarization.

Unit-II	Wire Elements: Dipoles, Monopoles, Loops and Helical	10 Hrs.
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Infinitesimal dipole, radiation fields, radiation resistance, radiation sphere, near field, far field directivity, small dipole, finite length dipole, half wave length dipole, linear elements near or on infinite perfect conductors, Monopole antenna, Folded dipole.

Design of dipole and monopole antenna. Loop Antenna: Small circular loop, comparison of small loop with short dipole, Ferrite loop, Radiation patterns, its parameters, and their applications.

Helical Antennas: Input impedance matching, Axial mode and normal mode propagation, Circular polarization using Helical Antenna.

Unit-III	Arrays	10 Hrs.
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Linear arrays, Array of two isotropic point sources, linear arrays of N elements, principle of pattern multiplication applicable to non-isotropic sources, Phase scanning arrays, broadside and End-fire Array, Increased Directivity end fire array, Calculations of Directivity, Beam width, Maxima and null directions for N-element Array, basics of planar arrays. Design of Yagi antenna and Log Periodic antenna.

Unit-IV	Micro strip Antenna	6 Hrs.
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Micro strip antenna (MSA): Introduction, Feeding Techniques, Regular Shape MSAs (Rectangular, Circular, Equilateral Triangular), Design of Regular shape MSAs

Unit-V	Aperture Antennas	6 Hrs.
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Horn Antennas: E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn, Conical Horn Reflector Antennas: Introduction, Plane Reflector, Corner Reflector, Parabolic Reflector, Design considerations.

Radiating Systems Laboratory (22PCET6020L)

List of Laboratory Experiments: (Any 8)

1. Study of Antenna types
2. Plot Radiation Pattern of dipole and monopole using Antenna trainer kit/ simulation software
3. Plot Radiation Pattern of dipole for varying length using simulation software
4. Design of RMSA using simulation software
5. Design of CMSA using simulation software
6. Design of ETMSA using simulation software
7. Plot Radiation Patterns of Microstrip antenna using Antenna trainer kit
8. Design of Broad side-end fire array
9. Study of pattern multiplication
10. Design of phase scanning array.
11. Gain measurement using three antenna methods.
12. Radiation pattern measurement.

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. C. A. Balanis, Antenna Theory: Analysis and Design 3rd Edition, John Wiley & Sons, Hoboken, NJ, 2005.
2. G. Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House, 2002.

Reference Books

1. R. E. Collin, Antennas and Radio Wave Propagation, International Student Edition, McGraw Hill.
2. John D Kraus, Ronald J Marhefka, and Ahmed S Khan, "Antennas and Wave Propagation", Tata McGraw Hill, 4th Edition, 2010.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Power Electronics (RCP23ECPE601)	
Power Electronics Laboratory(RCP23ELPE601)	

Pre-requisite:

- Basic Electrical Engineering & Digital Electronics
- Engineering Mathematics III
- Electronics Circuit Design

Course Objectives:

- To develop the understanding of fundamental principles of power electronics. introduce mathematical modelling, time domain analysis & frequency domain analysis.
- To disseminate various power electronic semiconductor devices and their characteristics
- To develop the concept of power electronic converters and their topologies.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the features and characteristics of power semiconductor devices.	L2	Understand
CO2	Analyze and Design triggering, commutation and protection circuits	L6	Create
CO3	Analyze, design, and evaluate AC–DC and AC–AC converters based on performance parameters	L4	Analyze
CO4	Evaluate and compare DC-DC and DC–AC converters for performance-based applications	L5	Evaluate

Power Electronics Laboratory (22PEET7043L)

List of Laboratory Experiments: (Any 8)

1. To study V-I characteristics of SCR, DIAC and TRIC.
2. To study V-I characteristics of IGBT.
3. To study different triggering circuits for SCR R Triggering circuit, RC triggering circuit
4. To study class B commutation circuit of SCR.
5. To study Half wave-controlled rectifiers using SCR.
6. To study AC phase control circuit using DIAC and TRIAC.
7. To study totem pole gate triggering circuit for MOSFET.
8. To study uncontrolled and controlled rectifiers.
9. To Study a controlled rectifier with (i) Source Inductance (ii) Freewheeling diode.
10. To study buck and boost converters.
11. To study fly back converters.
12. To study single phase DC to AC converters.
13. To study AC to AC converters.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Text Books

1. N. Mohan, T. M. Undeland, W. P. Robbins, "Power Electronics: Converters Application and Design", John Wiley & Sons, 2nd edition, 2003.
2. M. H. Rashid, "Power Electronics: Circuits, Devices, and Applications", Pearson Education India, 4th edition, 2014.
3. P.S. Bhimbra, "Power Electronics", Khanna Publishers, 5th edition, 2012.

Reference Books

1. P.C. Sen, "Modern Power Electronics", Wheeler publications, 1st edition, 2005.
2. Ramamurthy, "Thyristor & Their Applications", East-West Press, 2nd edition, 1998.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Digital VLSI Design (RCP23ECPE602)	
Digital VLSI Design Laboratory (RCP23ELPE602)	

Pre-requisite:

- Electronics Circuit Design
- Digital System Design
- Integrated Circuits

Course Objectives:

- To highlight the circuit design issues in the context of VLSI technology.
- To provide understanding of VLSI circuit design using different design styles.
- To provide introduction to HDL programming.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe transistor scaling and VLSI circuit performance.	L2	Understand
CO2	Realize logic circuits using different design styles.	L3	Apply
CO3	Explain the operation of memory, storage circuits and data path elements.	L2	Understand
CO4	Simulate and synthesize digital circuits using HDL language.	L6	Create

Digital VLSI design(RCP23ECPE602)

COURSE CONTENTS

Unit-I	MOSFET Layout and Scaling	8 Hrs.
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MOSFET Scaling: Types of scaling, short channel effects Layout: Lambda based design rules (CMOS), MOSFET capacitances.

Unit-II	MOS Circuit Design Styles	10 Hrs.
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CMOS INVERTER Circuit Analysis: Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter. Comparison of all types of MOS inverters. Design of CMOS inverters and its layout. Design styles: Static CMOS, Dynamic CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino logic, C2MOS, NORA logic, NP Domino logic, Realization of Multiplexer (up to 4:1 Mux), Encoder, Decoder, SR Latch, JK FF, D FF, 1 Bit Shift Register design in different design styles and their layouts

Unit-III	Memory and Storage circuits	9 Hrs.
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ROM array, SRAM (operation, design strategy, leakage currents, read /write circuits), layout of SRAM. DRAM (Operation of 1T, 3T, operation modes, refresh operation, Input-Output circuits), layout of DRAM.

Unit-IV	Data path design	9 Hrs.
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Full adder, Ripple carry adder, CLA adder, Carry Skip Adder, Carry Save Adder and carry select adder, Array Multiplier, Barrel shifter.

Unit-V	Design methods	6 Hrs.
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Semi-custom Full custom design PLA PAL PROM FPGA PLD. Introduction to VHDL.

Digital VLSI design Laboratory(RCP23ELPE602)

List of Laboratory Experiments: (Any Eight)

1. To study MOS characterization using simulation software
2. Static analysis of CMOS Inverter
3. Dynamic analysis of CMOS Inverter
4. Multiplexer design using pass transistor and transmission gate logic style.
5. 1-bit CMOS Adder design using static CMOS logic style
6. 1-bit CMOS mirror Adder design
7. To write VHDL/Verilog Program for flip flops
8. To write VHDL/Verilog Program for adders
9. To write VHDL/Verilog Program for multiplexers
10. Design and simulation of barrel shifter circuit in SPICE
11. To write HDL code and simulation of barrel shifter

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Text Books

1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, Tata McGraw Hill, Third Edition, 2012.
2. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, PHI, Second Edition, 2017.

Reference Books

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson Education, Second Edition, 2003.
2. JP. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley Sons, First Edition, 2006.
3. Frank Vahid, Digital Design with RTL design, VHDL and VERILOG, John Wiley and Sons Publisher, Second Edition, 2011.
4. Neil H. E. Weste, David Harris and Ayan Banerjee, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson Education, 3rd Edition, 2006.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Operating Systems (RCP23ECPE603)	
Operating Systems Laboratory (RCP23ELPE603)	

Pre-requisite:

- Structured Programming using C

Course Objectives:

- To introduce operating system as a resource manager, its evolutions and fundamentals.
- To understand the structure, functions and characteristics of computer system.
- To analyze, evaluate and implement different policies for scheduling, deadlocks, memory management, synchronization, file management & I/O.
- To understand real time applications of an operating system.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental concepts of OS.	L2	Understand
CO2	Analyze the management policies adopted by processes, memory, file handling and I/O operations.	L4	Analyze
CO3	Apply the algorithms used for memory management, CPU scheduling, disk scheduling and concepts related to deadlock.	L3	Apply
CO4	Apply appropriate memory mapping, memory allocation methods in Real Time Operating Systems.	L3	Apply

Operating Systems Laboratory (RCP23ELPE603)

List of Laboratory Experiments: (Any Eight)

1. To implement Linux commands.
2. To implement linux shell script.
3. To implement preemptive and non-preemptive algorithms.
4. Implement Banker's Algorithm for deadlock avoidance.
5. To implement concept of memory management.
6. To implement demand and virtual memory implementation.
7. To implement file allocation strategies.
8. To implement disk scheduling techniques.
9. To implement file organization techniques.
10. To implement RTOS scheduling techniques.

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. A. S. Tanenbaum, "Modern Operating Systems", Pearson, 4th Edition, 2015.
2. Silberschatz A, Galvin P, and Gagne G, "Operating System Concepts", Wiley, 10th Edition, 2018.

Reference Books

1. William Stallings, "Operating System-Internal and Design Principles", Pearson, 9th Edition, 2018.
2. Rajib Mall, "Real Time Systems: Theory and Practice", Pearson Education, 1st Edition, 2007.
3. Achyut S. Godbole, "Operating Systems", Tata McGraw Hill Education, 3rd Edition, 2011.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Big Data Analytics (RCP23ECPE604)	
Big Data Analytics Laboratory (RCP23ELPE604)	

Pre-requisite

- Database Management System

Course Objectives:

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the challenges of big data and scope of Hadoop and NoSQL for solving them.	L2	Understand
CO2	Use Map Reduce for Big Data processing	L3	Apply
CO3	Apply software tools for big data analytics for interpretation of business models.	L3	Apply
CO4	Examine the capabilities of big data using Apache Spark.	L4	Analyze

Big Data Analytics(RCP23ECPE604)

COURSE CONTENTS

Unit-I Introduction to Big Data Analytics Hadoop 7 Hrs.

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

Unit-II NoSQL 7 Hrs.

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

Unit-III MapReduce 8 Hrs.

Introduction, The Map Tasks, The Reduce Tasks, Combiners, Components of MapReduce, Details of MapReduce Execution, MapReduce Algorithms and applications: Matrix-Vector Multiplication, Word count, Sorting, Relational Algebra Operations

Unit-IV Techniques in Big Data Analytics 10 Hrs.

Finding Similar Item: Nearest Neighbour Search, Similarity of Documents. Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications and stream queries

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

Link analysis: Page rank algorithm, Structure of web

Mining Social - Network Graphs : Social Networks as Graphs, Types of Social Networks, Clustering of Social Network Graphs, Clique Percolation Method.

Unit-V Big Data Analytics using Apache Spark 10 Hrs.

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

Big Data Analytics Laboratory(RCP23ELPE604)

List of Laboratory Experiments: (Any Eight)

1. Execution of Hadoop file handling commands.
2. Execution of PIG SCRIPTING language.
3. Execution of HIVE SCRIPTING language.
4. Design graphical data store and querying using Neo4j.
5. Execution of MongoDB CRUD commands.
6. Execution of word count using MapReduce.
7. Execution of Matrix multiplication using MapReduce
8. Execution of page rank algorithm.
9. Implementation of Apriori algorithm in Python.
10. Execution of Spark application to perform data Analysis using PySpark.

Text Books

1. Radha Shankarmani, M Vijayalakshmi, “Big Data Analytics”, Wiley, 2nd Edition, 2016.
2. Alex Holmes, “Hadoop in Practice”, Manning Press, Dreamtech Press, 2nd Edition, 2015.
3. Holden Karau, Andy Konwinski, Matei Zaharia, “Learning Spark” O’Reilly, 2nd Edition, 2015.

Reference Books

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Big Data Series, 1st Edition, 2017
2. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing Limited , 1st Edition, 2013.
3. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publications, 2nd Edition, 2016.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Data Compression and Encryption (RCP23ECPE605)	
Data Compression and Encryption Laboratory (RCP23ELPE605)	

Pre-requisite:

- Mathematics for Telecommunication Engineering
- Signals & Systems

Course Objectives:

- To introduce different lossy and lossless compression for text audio, image and video.
- To introduce the concept of Symmetric and Asymmetric key cryptography and its applications in security protocols.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe various lossy and lossless techniques	L2	Understand
CO2	Apply various compression techniques for compression of text, image, audio and video.	L3	Apply
CO3	Describe the range of different cryptosystems and various network security related protocols.	L2	Understand
CO4	Analyze how the basic design criteria for various cryptosystems like confusion, diffusion and number theory are used in cryptographic techniques.	L4	Analyze

Data Compression and Encryption (RCP23ECPE605)

COURSE CONTENTS

Unit-I	Text Compression	10 Hrs.
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Introduction to data compression, Comparison of lossy and lossless compression, Modelling and Coding, Compression Parameters.

Huffman Coding, Adaptive Huffman Coding, Arithmetic coding, Dictionary based compression: Static and Dynamic Dictionary, LZ77, LZ78, LZW.

Unit-II	Image Compression	6 Hrs.
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Differential lossless compression DPCM, JPEG-LS, DCT, JPEG, JPEG 2000.

Unit-III	Audio and Video Compression	5 Hrs.
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Digital Audio, law and A law commanding, MPEG-1 Audio layer (MP3 audio format). Analog Video, Digital Video, MPEG-2, H.261 encoder and decoder.

Unit-IV	Symmetric key cryptography & Key management	8 Hrs.
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Introduction: Security Goals, Security techniques Cryptography and Steganography, Cryptographic attacks. Symmetric Key Cryptography: Substitution cypher, Transposition Cypher, Stream and Block cypher. DES, Double DES, Triple DES, AES. Key management, Diffie- Hellman Key Exchange.

Unit-V	Asymmetric key cryptography and Message Integrity	8 Hrs.
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Prime numbers, Fermats and Euler's theorem, Chinese Remainder theorem. Principles of Public Key cryptosystem, RSA. Message Integrity: Message authentication and Hash functions, SHA, HMAC, Digital Signature Standard.

Unit-VI	Network Security	5 Hrs.
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Email, PGP, S/MIME, Intrusion detection system, Secure Electronic transaction, X.509 authentication service, Introduction to cryptocurrency security.

Data Compression and Encryption Laboratory (RCP23ELPE605)

List of Laboratory Experiments: (Any 8)

1. To find compression ratio after compression of various file formats.
2. To implement Huffman coding.
3. To implement Arithmetic coding.
4. To implement μ law and A law companding for Audio compression.
5. To implement DCT for image compression.
6. To implement Substitution cypher for text/ image.
7. To implement Transposition cypher for text/ image.
8. To implement square and multiply algorithm
9. To implement Fermat's theorem.
10. To implement RSA.
11. To implement Diffie-Hellman Key exchange mechanism
12. To implement PGP.
13. Case study on specific topics.
14. To study X.509 certificate format by downloading few samples from internet.

(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. Khalid Sayeed, "Introduction to Data Compression", Elsevier, 5th Edition, 2017.
2. William Stallings, "Cryptography and Network Security Principles and Practices", Pearson Education, 5th Edition, 2020.
3. Behrouz A. Frozen, "Cryptography and Network Security", Tata McGraw-Hill, 3rd Edition, 2015

Reference Books

1. David Saloman, "Data Compression: The Complete Reference", 4th Edition, Springer, 2007.
2. Mark Nelson, Jean- Loup Gailly, "The Data Compression Book", 2nd Edition, BPB Publications, 2014.
3. Atul Kahate, "Cryptography and Network Security", McGraw-Hill, 4th Edition, 2019

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Data Analytics (RCP23ECPE606)	
Data Analytics Laboratory (RCP23ELPE606)	

Pre-requisite

- Mathematics for Telecommunication Engineering

Course Objectives:

- Understanding basic principles of probability, hypothesis testing and correlation between data.
- Apply the concepts of Data Analysis using Sampling theory.
- Apply Linear Programming methods to solve engineering problems.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify the relationship amongst various attributes of sample data sets using suitable techniques.	L4	Analyze
CO2	Perform data cleaning and transformations on a given dataset.	L3	Apply
CO3	Perform data modelling using regression and classification methods	L3	Apply
CO4	Apply dimensionality reduction on high dimensional datasets.	L3	Apply

Data Analytics (RCP23ECPE606)

COURSE CONTENTS

Unit-I	Data Exploration	8 Hrs.
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Data objects and attributes: nominal, binary, ordinal, numeric, discrete, continuous
Characteristics of datasets: dimensionality, sparsity, resolution; Types of data sets: record data, data matrix, graph-based data, sequential data, sequence data, time-series data, spatial data. Seven Stages of Data Visualization, Types of charts (comparison, distribution, composition, relation- ship), Structured Data: bar chart, pie chart, histogram, stacked bar graph, box plot, scatter plot, heat map, line chart, Node-link, dual axis chart. Unstructured Data: word count, bar chart, word tree, line chart diagrams, Word clouds.

Unit-II	Descriptive Statistics	6 Hrs.
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Population Vs Sample; Measure of Central Tendency: arithmetic mean, weighted mean, median, mode, grouped and ungrouped data, empirical relationship between mean, median and mode, geometric mean, harmonic mean and outliers; Measure of Dispersion: Range, quartile deviation, mean deviation, standard deviation, variance, empirical relationship between measures of dispersion, absolute and relative dispersion, skewness, kurtosis and histogram; Measure of Position: Quartiles, interquartile range, semi interquartile range, percentile, percentile rank, box and whisker plot.

Unit-III	Sampling Theory	12 Hrs.
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Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small sample. Test of significance for large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test. Chi-square test, Test for the Goodness of fit, Association of attributes. ANOVA: One way classification, Two-way classification

Unit-IV	Regression & Decision Tree	10 Hrs.
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Explore algorithms such as: linear regression, polynomial regression, logistic regression. Decision tree using Gini index and CART (Classification and Regression Tree)

Unit-V	Feature Engineering	6 Hrs.
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Curse of Dimensionality, Feature Selection: Univariate methods and Multivariate methods.

Data Analytics Laboratory (RCP23ELPE606)

List of Laboratory Experiments: (Any Eight)

1. Analysis of different types of datasets.
2. Plotting of probability distribution using different dataset.
3. Plotting and visualization of dataset using different types of graphs
4. Different types data cleaning methods.
5. Implementation of logistic regression model for predictive analysis.
6. Implementation of linear regression model for predictive analysis.
7. Implement PCA on dataset with high dimensionality and perform prediction using KNN.
8. Implement clustering methods on unsupervised dataset.
9. Hypothesis testing for given dataset.
10. ANOVA using dataset

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

Text Books

1. Dr. J Ravichandran, “Probability and Statistics for Engineering”, 6th Edition, Wiley, 2019.
2. Ethem Alpaydin, “Introduction to Machine Learning”, 4th Edition, MIT Press, 2020.

Reference Books

1. Seymour Lipschut, “Probability”, 3rd Edition, McGraw-Hill, 2021.
2. S. C. Gupta, V. K. Kapoor, “Fundamentals of Mathematical Statistics”, 12th Edition, Sultan Chand & Sons, 2020.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Basics of IOT (RCP23ECPE607)	
Basics of IOT Laboratory (RCP23ELPE607)	

Pre-requisite:

- Microcontroller & Applications
- Analog & Digital Communication

Course Objectives:

- To understand basic building block of IoT.
- To understand various IoT protocols.
- To analyse IoT data using Data handling.
- To study design methodology in IoT through case studies.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain concepts, functional blocks, and communication methodologies related to IoT	L2	Understand
CO2	Introduce Different components of IoT.	L2	Understand
CO3	Introducing sensor, actuator integration with Raspberry Pi.	L3	Apply
CO4	Explain various methods of data handling	L2	Understand
CO5	Design and exploring different applications of IoT.	L6	Create

Basics of IOT (RCP23ECPE607)

COURSE CONTENTS

Unit-I	Introduction to Internet of Things	10 Hrs.
Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication models, IoT Protocols, Sensor Networks.		
Unit-II	Components in IoT	4 Hrs.
Examples of sensors and actuators sensor like LM35 (temperature), IMU MPU 9250 / 6050; Actuators like – dc stepper motors, servo motors		
Unit-III	Machine-to-Machine Communications	5 Hrs.
Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with ESP32		
Unit-IV	Introduction to IoT ready platforms - typically Raspberry Pi	10 Hrs.
Raspberry Pi features & specifications, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi, Implementation of IoT with Raspberry Pi.		
Unit-V	Introduction to Data Analytics	5 Hrs.
Data acquisition and storage, Data Handling and Analytics		
Unit-VI	Cloud Computing	8 Hrs.
Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring		

Basics of IOT Laboratory (RCP23ELPE607)

List of Laboratory Experiments: (Any Eight)

1. Serial Monitor, LED, Servo Motor – Controlling
2. Distance Measurement of an object
3. Controlling relay state based on ambient light levels using LDR sensor
4. Basic Burglar alarm security system with the help of PIR sensor and buzzer
5. Displaying humidity and temperature values on LCD
6. Advanced burglar alarm security system using PIR sensor, buzzer and keypad. (Alarm gets disabled if correct keypad password is entered)
7. Upload humidity & temperature data to Thing Speak, periodically logging ambient light level to Thing Speak
8. Introduction to HTTP. Hosting a basic server from the ESP32 to control various digital based actuators (led, buzzer, relay) from a simple web page
9. Displaying humidity and temperature data on a web-based application
10. Python program to read GPS coordinates from Flight Controller
11. Controlling LEDs/Motors from an Android/Web app, Controlling AC Appliances from an android/web app with the help of relay
12. Advanced burglar alarm security system with the help of PIR sensor, buzzer and keypad.

Text Books

1. P. Raj and A. C. Raman “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, (CRC Press), 1st Edition, 2022.
2. T., kemo, karvinen and V. Valtokari, “Make Sensors”, Maker Media, 1st edition 2014.
3. A. Bahga and V. Madiseti, “Internet of Things: A Hands-on Approach”, Universities Press, 4th Edition, 2019.

Reference Books

1. W. Dargie, C. Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice”, Wiley, 2011.
2. C. Bell, “Beginning Sensor networks with Arduino and Raspberry Pi” Apress, 2013.
3. J. Fraden “Handbook of Modern Sensors-Physics, Design and Applications”, 4th Edition, Springer.

NPTEL Web Course

1. https://onlinecourses.nptel.ac.in/noc25_ee186/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs65/preview
3. https://onlinecourses.swayam2.ac.in/ntr24_ed44/preview

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Machine Learning & Applications (RCP23ECMD601)	
Machine Learning & Applications Laboratory (RCP23ELMD601)	

Pre-requisite:

- Mathematics for Telecommunication Engineering
- Digital Signal Processing

Course Objectives:

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Recall key concepts and fundamentals relevant to machine learning and Applications.	L2	Understand
CO2	Explain the theoretical foundations of linear, non-linear models, and the principles behind probabilistic and advanced Machine Learning models.	L2	Understand
CO3	Apply various machine learning and Signal Processing algorithms and techniques, in problem solving.	L3	Apply
CO4	Analyze the performance and suitability of different learning techniques for specific applications	L4	Analyse

Machine Learning & Applications (RCP23ECMD601)

COURSE CONTENTS

Unit-I	Linear Models for Regression	8 Hrs.
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Linear Regression with one variable, Cost function, Gradient descent, Polynomial Curve fitting, least squares, Geometry of least squares, Regularisation.

Unit-II	Linear Models for Classification	8 Hrs.
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Classifying with k-Nearest Neighbors, Decision Trees, Naive Bayes, Logistic regression, Least Squares for Classification.

Unit-III	Non-Linear Models-Neural Networks	8 Hrs.
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Parameter Optimization, Gradient descent Optimization, Evaluation of error-function derivatives, A simple example, Efficiency of backpropagation.

Unit-IV	Probabilistic models and Expectation Maximisation Algorithm	8 Hrs.
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Key management

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

Unit-V	Applications of Machine Learning in Audio classification, Speech	10 Hrs.
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Recognition Image Processing

Signal Compression with SVD, Dimensionality reduction with PCA, LSTMs and CNNs, Hidden Markov Models, Viterbi Algorithm, Transfer Learning.

Machine Learning & Applications Laboratory (RCP23ELMD601)

List of Laboratory Experiments: (Any Eight)

1. Given a dataset, Predicting feature values with Linear Regression.
2. Binary Classification using Logistic Regression.
3. Find the minimum of a polynomial by Steepest Descent Method.
4. Dimensionality reduction by Principal Component Analysis.
5. Classification with Naive Bayesian algorithm.
6. Image Compression and Reconstruction by SVD Decomposition.
7. Polynomial Regression: To generate a dataset and fit a Polynomial through it.
8. Reducing Overfitting by Ridge and Lasso Regression of a Given Dataset.
9. Backpropagation Implementation in Simple Neural Network with one hidden layer.
10. Implementation of Dropout Using Convolutional Neural Network.
11. Implementation Of Data Augmentation in Python.
12. Reducing Overfitting by Ridge and Lasso Regression of a Given Data.

Text Books

1. Tom M. Mitchell, Machine Learning, McGraw Hill Education, 2020.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books

1. Ethem Alpaydin, Introduction to Machine Learning, 2020, MIT Press.
2. Kevin P. Murphy, Machine Learning, A Probabilistic Perspective, 2012, MIT Press.

Program: Electronics and Telecommunication Engineering	T.Y.B. Tech
	Sem-VI
Project Stage - I (RCP23IPEL601)	

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 life- long learners.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze engineering problems considering cultural, social, environmental, and economic factors using appropriate tools.	L4	Analyze
CO2	Apply project-based learning to develop effective engineering solutions from existing ideas.	L3	Apply
CO3	Demonstrate teamwork and manage project development activities effectively.	L3	Apply
CO4	Integrate knowledge from different fields to enhance problem-solving and prepare for career opportunities.	L5	Evaluate
CO5	Develop project reports, IPR, and publications in standard formats following ethical practices.	L3	Apply

Project Stage - I (RCP23IPEL601)

COURSE CONTENTS

Syllabus:

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, etc.

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	T.Y.B. Tech
	Sem-VI
Constitution of India (RCP23ICHSX07)	

Course Objectives:

- To introduce the basic structure and features of the Indian Constitution.
- To understand Fundamental Rights, Directive Principles, and Fundamental Duties.
- To familiarize students with Union and State government institutions and constitutional amendments.
- To develop awareness of human rights and ethical responsibilities of engineers

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.	L2	Understand
CO2	Understand state and central policies, fundamental duties.	L2	Understand
CO3	Understand Electoral Process, special provisions.	L2	Understand
CO4	Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.	L2	Understand
CO5	Understand Engineering ethics and responsibilities of Engineers.	L3	Apply
CO6	Understand Engineering Integrity & Reliability.	L3	Apply

Constitution of India (RCP23ICHSX07)

COURSE CONTENTS

Unit-I Introduction to the Constitution of India 2 Hrs.

The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution, Fundamental Rights & its limitations.

Unit-II Directive Principles of State Policy 3 Hrs.

Relevance of Directive Principles, State Policy Fundamental Duties. Union Executives- President, Prime Minister, Parliament, Supreme Court of India.

Unit-III State Executives 3 Hrs.

Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.

Unit-IV Special Provisions 3 Hrs.

For SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights: Meaning and Definitions, Legislation Specific Themes in Human Rights, Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Co-Operative Societies.

Unit-V Scope & Aims of Engineering Ethics 3 Hrs.

Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Reference Books

1. Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) Prentice – Hall EEE, 19th / 20th Edn., 2001
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins "Engineering Ethics" Thompson Asia, 2003-08-05
3. Jain, M. P., Indian Constitutional Law, 8th Edition, LexisNexis, New Delhi, 2018.
4. Shukla, V. N., Constitution of India, 13th Edition, Eastern Book Company, Lucknow, 2017.
5. Austin, G., The Indian Constitution: Cornerstone of a Nation, Oxford University Press, New Delhi, 2019