Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur
(An Autonomous Institute)

Syllabus Booklet
Electronics and Telecommunication Engineering

Third Year B.Tech.

With Effect from Academic Year 2025-26

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

NEP Third Year B. Tech Electronics and Telecommunication Engineering Semester-V (w.e.f. 2025-2026)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme						Credit	
				L	T	P	TA [A]	Term Test 1 (TT 1)	Term Test 2 (TT 2)	Average of TT1 & TT2 [B]	ESE [C]	Total [A+B+C]	Credit	Total Credit
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 Laboratory			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 Laboratory			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 Laboratory			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**	**1**	**12**	**300**	**75**	**75**	**75**	**450**	**825**	**21**	**21**

Prepared by:
Prof. Dr. P.M.Goad

Checked by:
Prof. V. V. Patel

Prof. Dr. V. S. Patil
B.O.S Chairman

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NEP Third Year B. Tech Electronics and Telecommunication Engineering Semester-VI (w.e.f. 2025-2026)														
Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				ESE	Total	Credit	
				L	T	P	TA [A]	Term Test 1 (TT 1)	Term Test 2 (TT 2)	Average of TT1 & TT2 [B]	[C]	[A+B+C]	Credit	Total Credit
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 Laboratory			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			25	15	15	15	60	100	3	4
9	MD	RCP23ELMD601	Machine Learning & Applications Laboratory			2	25				25	50	1	
10	EL	RCP23IPEL601	Project Stage-I			4	50				50	100	2	2
11	HS	RCP23ICHSX07	Constitution of India	1									Audit	Audit
Total				**16**	**0**	**14**	**300**	**75**	**75**	**75**	**475**	**850**	**22**	**22**

Any 1 Programme Elective Course will offered

Prepared by: Prof. Dr. P.M.Goad

Checked by: Prof. V. V. Patel

Prof. Dr. V. S. Patil
B.O.S Chairman

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

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Program: Electronics and Telecommunication Engineering	T.Y.BTech	Semester: V
Digital Signal Processing (RCP23ECPC501)		
Digital Signal Processing Laboratory (RCP23ELPC501)		

Pre-requisite

1. Engineering Mathematics III
2. Signals and Systems

Course Objectives

1. To develop a thorough understanding of DFT and FFT and their applications.
2. To design digital filters and analyse their performance.
3. To understand the effects of poles and zeros in the frequency response of digital filters.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the concept of DFT and FFT and their use in analysis of the LTI system.	L4	Analyze
CO2	Apply the knowledge of LTI system to design FIR and IIR filter for given specifications and realize them.	L3	Apply
CO3	Analyze the discrete time LTI systems and processors for measuring the performance of digital filters.	L4	Analyze
CO4	Evaluate the effect of finite word length on FIR and IIR filter performance.	L5	Evaluate

Digital Signal Processing (RCP23ECPC501)
Course Contents

Unit-I Discrete Fourier Transform Fast Fourier Transform 08 Hrs.

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 08 Hrs.

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 08 Hrs.

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.

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 06 Hrs.

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:

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)

The Oral/Practical examination will be based on the entire syllabus, including the experiments performed during laboratory sessions

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. Schafer, "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.	Semester: V
Wave Theory & Radio Frequency Design (RCP23ECPC502)		
Wave Theory & Radio Frequency Design Laboratory (RCP23ELPC502)		

Prerequisite: Mathematics for Telecommunication Engineering, Electrical Networks.

Course Objective(s):

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

Course Outcomes:

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.	L3	Application
CO5	Develop passive RF filter configurations for given specifications.	L3	Application

Wave Theory & Radio Frequency Design (RCP23ECPC502) Course Contents

Unit-I 08 Hrs.

Electrostatics: Coulomb's Law, Gauss's Law and its applications, Electric Potential, Relationship between E and V, Electric Dipole and flux lines, Convection and Conduction Currents, Electric Boundary Conditions, Poisson's and Laplace's Equations, Uniqueness Theorem, General Procedure for solving Poisson's or Laplace's Equations.

Magnetostatics: Biot-Savart's Law, Ampere's Circuital Law and its applications, Magnetic Flux density, Maxwell's equations for Static Fields, Magnetic Scalar and Vector potentials, Magnetic boundary conditions.

Unit-II 08 Hrs.

Time varying Fields: Faraday's Law, Transformer and Motional Electromotive Forces, Displacement Current Maxwell's equations in point form and integral form, Boundary conditions for time varying field, magnetic vector potential, Time harmonic fields.

Electromagnetic Wave Propagation: Derivation of Wave equation and its solution, Wave Propagation in lossy dielectrics, Plane waves in loss less dielectrics, free space and good conductors, Power and Poynting Vector, Reflection of a Plane wave at normal incidence and oblique incidence.

Unit-III 05 Hrs.

Single and Multiport Networks: Basic Definitions, Interconnecting Networks, Series Connection of Networks, Parallel Connection of Networks, Cascading Networks.

The Scattering Matrix, Reciprocal Networks and Lossless Networks, A Shift in Reference Planes, Power Waves and Generalized Scattering Parameters, Practical Measurements of S-Parameters.

The Transmission (ABCD) Matrix, Relation to Impedance Matrix and Scattering Matrix.

Unit-IV 04 Hrs.

Importance of Radio Frequency Design: RF behaviour of Passive Components High-Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors.

Unit-V 07 Hrs.

Transmission Lines: Parameters, Transmission line equations, Input impedance, reflection coefficient, Standing wave ratio.

Smith Chart

From Reflection Coefficient to Load Impedance

Reflection coefficient in Phasor Form, Normalised Impedance Equation, Parametric Reflection Coefficient Equation, Graphical Representation.

Impedance Transformation

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

Unit-VI 08 Hrs.

RF Filter Design: Basic Resonator and Filter configurations

Filter Types and Parameters, Low-Pass Filter, High-Pass Filter, Bandpass and Bandstop 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

Suggested 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.

The Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. William H. Hayt and John A Buck, "Engineering Electromagnetics", Tata McGraw-Hill Publishing Company Limited, 9^{th} Edition, 2020.

2. Ludwig, Reinhold & Bretchko, Pavel, "RF circuit design: Theory and applications, Prentice-Hall, 2^{nd} Edition, Upper Saddle River, N.J, 2011.

Reference Books:

1. Matthew N. O. Sadiku, S. V. Kulkarni, "Principles of electromagnetics", Oxford University Press, 6^{th} Edition, 2015.

2. Pozar, David M, "Microwave Engineering", Hoboken, NJ: Wiley Publication, 2012.

Program: Electronics and Telecommunication Engineering	T.Y.BTech	Semester: V
Analog and Digital Communication (RCP23ECPC503)		
Analog and Digital Communication Laboratory (RCP23ELPC503)		

Pre-requisite

1. Signal Systems

Course Objectives

1. To Learn various Analog and Digital Communication Systems.
2. 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.	L6	Create

Analog and Digital Communication (RCP23ECPC503) Course Contents

Unit-I Analog Communication systems and reception 08 Hrs.

Introduction to communication system, Amplitude modulation, Frequency modulation, mathematical analysis of FM signal, Modulation index, BW requirement, pre-emphasis and de-emphasis, narrow wideband FM. Radio receivers characteristics and TRF and super-Heterodyne receiver.

Unit-II Sampling Theorem and Pulse-Modulation Techniques 08 Hrs.

Sampling theorem and aliasing error. Types of Pulse modulation- PAM, PWM and PPM. PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Commanding, DPCM, Adaptive DPCM, DM and Adaptive DM, Noise in PCM and DM.

Unit-III Digital Modulation Techniques 10 Hrs.

ASK- Modulator, M-ary scheme, Coherent ASK Detector, FSK- Modulator, Non- Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK and QAM.

Unit-IV Baseband Transmission and Optimal Reception of Digital Signal 04 Hrs.

Baseband Transmission and Optimal Reception of Digital Signal A Baseband Signal Receiver, Probability of Error, Optimum Receiver, Coherent Reception, ISI, Eye Diagrams.

Unit-V Source and error control coding 08 Hrs.

Entropy, Source Encoding Theorem, Shannon Fano Coding, Huffman Coding, Mutual Information, Channel Capacity, Error Control Coding, Linear Block Codes, Cyclic Codes

Analog and Digital Communication Laboratory (RCP23ELPC503)

List of Laboratory Experiments:

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)

    (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)

    The Oral/Practical examination will be based on the entire syllabus, including the experiments performed during laboratory sessions

Text Books

1. T. L. Singal, "Analog and Digital Communications", Tata Mc-Graw Hill, 1st Edition 2014..
2. Kennedy, Davis, "Electronics Communication Systems", Tata Mc-Graw Hill, 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	Semester: V
Radar Engineering (RCP23ECPE501)		
Radar Engineering Laboratory (RCP23ELPE501)		

Pre-requisite

1. Electromagnetic Wave Propagation
2. Analog Communication

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain generalized concept of RADAR & its applications	L2	Understand
CO2	Analyse 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 06 Hrs.

Basic Radar, basic ranger equation, Block Diagram, Radar Frequencies, Applications of Radar.

Unit-II Radar Range Equation 08 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 08 Hrs.

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

Unit-V Radar Transmitter and Receiver 08 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, PPI, H-Scope, A-Scope, B-Scope, C-Scope, D-Scope, E-Scope, R-Scope etc.

Radar Engineering Laboratory (RCP23ELPE501)

List of Laboratory Experiments:

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.)

Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books

1. Merrill Skolnik," Introduction to Radar Systems", Tata McGra Hill, 2nd Edition, 2010.
2. G S N Raju, "Radar Engineering", Willey publication, 1st Edition, 2020.

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	Semester: V
Computer Organization and Architecture (RCP23ECPE502)		
Computer Organization and Architecture Laboratory(RCP23ELPE502)		

Pre-requisite

1. Digital System Design

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the basic concepts and structure of computers and functionality of central processing unit.	L2	Understand
CO2	Implement computer arithmetic operations.	L3	Apply
CO3	Explain the basics of instructions 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 04 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 08 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 04Hrs.

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 08 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-VI I/O Organization 04 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:

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 belwo 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	Semester: V
Control Systems (RCP23ECPE503)		
Control Systems Laboratory (RCP23ELPE503)		

Pre-requisite

1. Basic Electrical Engineering & Digital Electronics
2. Engineering Mathematics –I
3. Engineering Mathematics - II

Course Objectives

1. To provide fundamental concept of control systems.
2. To introduce mathematical modelling, time domain analysis & frequency domain analysis.
3. To develop concepts of stability and its assessment criteria of the system.
4. 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.	L4	Analyze
CO3	Analysis of systems in time and frequency domain.	L4, L5	Analyze, Evaluate
CO4	Analyze & 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 (RCP23ECPE503)
Course Contents

Unit-I Introduction to Control Systems 08 Hrs.

Introduction: Open loop, closed loop systems, feed forward control, adaptive control systems, examples of control systems. Modeling: Types of models, impulse response model, transfer function model. Dynamic Response: Standard test signals, transient and steady state behavior control systems, steady state errors in feedback control systems and their types.

Unit-II Mathematical Modeling of Systems 10 Hrs.

Conversion of block diagram to signal Flow Graph and Vice-versa., Transfer Function models of various Electrical systems, Block diagram reduction for single inputs single outputs(SISO) and multiple inputs multiple outputs(MIMO) systems, signal flow graph, Mason's gain rule.

Unit-III State Variable Models 07 Hrs.

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.

Unit-IV Stability Analysis 10 Hrs.

Concept of stability, Routh stability criterion, Root-locus, general rules for constructing root-locus, Magnitude and phase plot; Method of plotting Bode plot; Stability margins on the Bode plots, Nyquist stability criterions gain and phase margins. Case study on stability of Control System in Thermal Power Plant.

Unit-V Controllers & Compensators 05 Hrs.

Introduction of PI, PD, and PID Controllers, Lead and Lag compensators. Case study on a model-driven PID control system.

Control Systems Laboratory(RCP23ELPE503)

List of Laboratory Experiments:

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.)

Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books

1. I. J. Nagrath, Madan.Gopal, Control System Engineering, New Age International Publication, 7^{th} Edition, 2021.
2. K.Ogata, Modern Control Engineering, Pearson Education, 5^{th} Edition, 2015.

Reference Books

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

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

Pre-requisite

1. Mathematics for Telecommunication Engineering

Course Objectives

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications.
2. 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 sub-spaces.**	**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 06 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 07 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 05 Hrs.

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

Linear Algebra Laboratory(RCP23ELPE504)

List of Laboratory Experiments:

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.

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

Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Text Books

1. J. H. Kwak and S. Hong, "Linear Algebra", Second Edition, Springer, Boston, 2012.
2. Kolman, Bernard, and Hill, David Ross, "Elementary Linear Algebra", United Kingdom, Prentice Hall, 2000.

Reference Books

1. Stephen Andrilli and David Hecker, "Elementary Linear Algebra", 5th Edition, Academic Press, 2016.
2. Rudolf Lidl, Guter Pilz, "Applied Abstract Algebra", 2nd Edition, Springer, 2004.
3. Howard Anton, Robert C Busby, "Contemporary Linear Algebra", Wiley, 2003.
4. Gilbert Strang, "Introduction to Linear Algebra", 5th Edition, Cengage Learning, 2015.

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

Prerequisite: Digital System Design, Microcontroller & Applications.

Course Objective(s):

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

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe 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	Creat

Advanced Microcontroller (RCP23ECPE505) Course Contents

Unit-I 06 Hrs.

ARM Family and Cortex-M Architecture: Introduction to ARM Microcontrollers: ARM Cortex-M Family: ARM Cortex-M series overview (M0, M3, M4, M7), Features of ARM Cortex-M4: Harvard architecture, pipeline, and instruction set

Unit-II 08 Hrs.

Introduction to STM32 Microcontrollers: STM32 family overview (F0, F1, F4, L4 series), Features of STM32F401RE: processor core, clock speed, overview of bus architecture (AHB, APB), memory organization, memory mapping and peripherals, Introduction to STM32 development tools: STM32CubeIDE and STM32CubeMX.

Unit-III 8 Hrs.

GPIO and Interrupt Programming: GPIO Configuration: Input, output, alternate function, Pull-up/pull-down resistors and pin speed configuration, Basic input/output operations: LED blinking and push-button interfacing, Interrupt Handling NVIC and its configuration, External interrupts.

Unit-IV 9 Hrs.

Timers, PWM, and ADC: Timers and Delay Generation: Overview of STM32 timers, Configuring general-purpose timers for delay generation, PWM and Applications: PWM generation using timers, Controlling brightness of an LED and speed of a DC motor using PWM Analog-to-Digital Conversion (ADC): ADC architecture and configuration, Single-channel and multi-channel ADC, Interfacing analog sensors (e.g., temperature sensors).

Unit-V 9 Hrs.

Communication Protocols and Applications: Serial Communication (UART): Configuring UART for data transmission and reception, I2C and SPI Communication: Overview and comparison of I2C and SPI protocols, Configuring STM32F401RE for I2C and SPI communication, IoT Applications: Interfacing STM32F401RE with Wi-Fi modules (ESP8266/ESP32), Cloud integration using MQTT/HTTP protocols.

Advanced Microcontroller Laboratory (RCP23ELPE505)

List of Laboratory Experiments

Suggested Experiments:(Any 8)

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. NInterfacing 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.

The Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Joseph Yiu , "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Newnes Publications, 3^{rd} 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, 1^{st} 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 , 1^{st} Edition, 2018.
3. Carmine Noviello, ""Mastering STM32"", Leanpub, 1^{st} Edition, 2018.

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

Pre-requisite

1. Mathematics for Telecommunication Engineering

Course Objectives

1. To introduce the concepts and understanding of artificial neural networks and fuzzy logic
2. To introduce neural network design concepts.
3. To expose neural networks based methods to solve real world complex problems.
4. 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

(RCP23EPE506)
Course Contents

Unit-I Essentials of Artificial Neural Networks 04 Hrs.

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, Artificial Neuron Model, Operation of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, McCulloch-Pitts Model, Potential Applications of ANN, Classification Taxonomy of ANN Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement),Learning Rules

Unit-II Supervised Neural Networks 12 Hrs.

Feed forward neural network, Single-Layer feed forward architecture-Perceptron, Multiple-Layer feed forward architecture, Types of feed forward networks, Multi-layer perceptron, Training MLP: The back-propagation algorithm, Introduction to the concept of Support Vector Machine based classifier, GRADIENT-DESCENT algorithm, Generalization, Metrics for evaluation of classification method, Steps to use neural networks to data, Over fitting, Detecting over fit models: Cross validation

Unit-III Unsupervised Learning Neural Networks 12Hrs.

Competitive Learning Networks – Maxnet, Mexican Hat Net, Kohonen Self-Organizing Networks – architecture, training algorithm, K-means, Radial Basis Function (RBF) neural network – architecture and algorithm, and Discrete Hopfield networks.

Unit-IV Fuzzy logic 06 Hrs.

Introduction to fuzzy logic, Basic Fuzzy logic theory, Fuzzy sets - properties & operations, Fuzzy relation - Operations on fuzzy relations, Fuzzy Membership functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzification and Defuzzification methods, Fuzzy Inference Systems, Mamdani Fuzzy Models, Fuzzy knowledge-based controllers, Sugeno Fuzzy Models.

Unit-V Applications of Fuzzy Logic and Fuzzy Systems 06 Hrs.

Fuzzy pattern recognition, fuzzy C-means clustering, fuzzy image processing, Simple applica-

tions of Fuzzy knowledge-based controllers like washing machines, home heating system, and train break control.

Neural Network and Fuzzy Logic Laboratory (RCP23ELPE506)

List of Laboratory Experiments:

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

    (Minimum eight experiments from the belwo 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 , 3rd Edition, 2018

2. S. Rajasekaran, G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Systems And Evolutionary Algorithms: Synthesis And Applications”, Prentice hall Learning India,2nd Edition, 2017.

Reference Books

1. Thimothy 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	Semester: V
Database Management System(RCP23ECMD501)		
Database Management System Laboratory(RCP23ELMD501)		

Pre-requisite

1. Structured Programming using C
2. Object Oriented Programming using Java

Course Objectives

1. Learn and practice data modeling using the entity relationship and developing database designs.
2. 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, L4	Create, Analyze
CO3	Construct SQL queries to perform operations on the database.	L3	Analyze
CO4	Describe transaction management technique.	L2	Understand

Course Contents (RCP23ECMD501)

Unit-I Introduction to Databases and Data models 06 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 08 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 08 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 06 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(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, 7^{th} Edition, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database System, 7^{th} Edition, 2017.

Reference Books

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

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

Course Objectives

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

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

Environmental Science Tutorial

(RCP23ITHSX06)
Course Contents

Unit-I PSocial Issues and Environment 04 Hrs.

Ecological footprint and Carrying Capacity, Depleting nature of Environmental resources such as soil, water minerals and forests ,Carbon emissions and GlobalWarming.

Unit-II TDirective Principles of State Policy 04 Hrs.

Technological growth for Sustainable Development: Social, Economic and Environmental aspects of Sustainable Development, Renewable Energy Harvesting ,Concept of Carbon credit, Green Building ,Power and functions of Central Pollution Control Board and State Pollution Control Board.

Unit-III Environmental impact due to technology 05 Hrs.

Environmental impact due to technology: Impact of Energy on Environment, Flow of Energy in Ecological system, Environment Degradation due to Energy, Control of pollution from Energy, Consumerelectronics, power saving devices, energy from waste, energy use and conservation.

Text Books

1. R. Rajagopalan, "Environmental Studies From Crisis to Cure",Generic; 3rd edition, 2015.
2. Erach Bharucha, "Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education",Orient Blackswan Pvt Ltd, 3rd Edition, 2019 .
3. I.V Murali Krishna, Valli Manickam, Anil Shah, Naresh Davergave, "Environmental Management Science and Engineering for Industry", Butterworth-Heinemann, 2017.

Evaluation Scheme

1. Student should submit a report on the case study declared by teacher.
2. Audit point shall be awarded subject to submission of report of the case study declared by teacher.

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

Pre-requisite

1. Electronics Circuit Design
2. Digital System Design
3. Integrated Circuit
4. Python Programming Laboratory

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Define problem statement, formulation and solution by viewing relevant literature	L1	Remember
CO2	Identify alternate approaches to complete a project	L2	Understand
CO3	Apply project management skills by interacting and dividing project work among team member	L3	Apply
CO4	Develop technical, communication, and presentation skills	L6	Create

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

These areas may be updated based on technological innovations and project needs.

Guidelines

- 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.
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 1: Log Book Format

Sr	**Week (Start Date:End Date)**	**Work Done**	**Sign of Guide**	**Sign of Coordinator**
1				
2				

Table 2: Continuous Assessment Sheet

Sr	**Seat No**	**Name**	**Attendance**	**Log Book**	**Lit. Review**	**Understanding**	**Report**
			5	5	5	5	5
						Total	25

Table 3: Evaluation Sheet

Sr	**Seat No**	**Name**	**Selection**	**Design/Logic**	**HW/Prog.**	**Verification**	**Presentation**
			5	5	5	5	5
						Total	25

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

Prerequisite: Analog & Digital Communication

Course Objectives

1. To Learn various hardware network components.
2. To understand network reference models and process involved in data communication.
3. To analyse the protocols working at different layers.
4. To design and configure a network for an organization.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain basics of networks, models, protocols, devices	L2	Understand
CO2	Identify physical media & multiplexing techniques,	L3	Apply
CO3	Analyze data link layer protocols & error control,	L4	Analyze
CO4	Apply & evaluate routing algorithms and IP addressing	L5	Evaluate
CO5	Explain & analyze transport layer (TCP/UDP) services	L4	Analyze

Computer Networks (RCP23ECPC601)

Course Contents

Unit-I Introduction to computer network 08 Hrs.

Reference Models, OSI model, overview of TCP/IP, layer functions, services, peer to peer protocols, sockets and ports, Data encapsulation, Transmission mode, Networking devices: Repeater, hub, bridge, switch and routers, Network topology.

Unit-II Introduction to Physical Layer Services 04 Hrs.

Introduction to physical media, Coax, RJ 45, Optical fiber, twisted pair, bit transmission, frequency division multiplexing. Time division multiplexing.

Unit-III The Data Link Layer 10 Hrs.

Data link Layer Design Issues, Error Detection and Correction, Data Link Protocols, Sliding Window Protocols: Stop and Wait protocol, Go-back-n protocol, Selective-repeat protocol, Data Link Protocols: HDLC: High-Level Data Link Control, Channel Allocation Problem, Multiple Access Protocols.

Unit-IV The Network Layer 10 Hrs.

Network functions for the Network Layer Functions, Routing Algorithms: Distance vector and Link state routing, shortest path first algorithm: Dijikstra and Bellman Ford algorithm, Quality of Service. Network Layer In The Internet: The IP Protocol, IPv4 header, IP Addressing classfull and classless, CIDR notation, Subnetting, suppernetting, The Interior Gateway Routing Protocol: RIP, OSPF, and The Exterior Gateway Routing Protocol: BGP.

Unit-V The Transport Layer 10 Hrs.

The Transport Service, Elements of Transport Protocols, The Internet Transport Protocol: TCP and UDP, The Internet Transport Protocol: TCP:-Introduction to TCP, The TCP, Service Model, The TCP Protocol, The TCP Segment Header, UDP Header, TCP Connection Establishment, TCP Connection Release, Modelling TCP Connection Management, TCP Transmission Policy, TCP Congestion Control, TCP Timer Management.

Computer Networks Laboratory (RCP23ELPC601)

List of Laboratory Experiments

Suggested 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. Dijikstras Algorithm.
10. Bellman Ford Algorithm.
11. Network Packet Analysis using Wireshark.
12. Virtual LAN using CISCO Packet Tracer.

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

The Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. A. S. Tanenbaum, "Computer Network", Prentice Hall, 4^{th} Edition, 2003.
2. B. F. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 5^{th} Edition, 2022.

Reference Books:

1. Kurose, Ross, "Computer Networking", Addison Wesley, 7^{th} Edition, 2016.
2. William Stallings, "Data and Computer Communications", Pearson, 9^{th} Edition, 2011.
3. D. E. Comer, "Computer Networks And Internets", Prentice Hall,1^{st} Edition, 2008.
4. B. F. Forouzan, "TCP/IP Protocol Suite", Tata Mc-Graw Hill, 6^{th} Edition, 2008.

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

Prerequisite: Signals & Systems, Digital Signal Processing

Course Objectives

1. To cover the fundamentals, mathematical models and transformation techniques in digital image processing.
2. 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 04 Hrs.

Coordinate representation and Pixel, Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbors of pixel adjacency connectivity, regions and boundaries, Distance measures.

Unit-II Image Enhancement 12 Hrs.

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 (Neighborhood 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 Domain: The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters.

Unit-III Image Restoration and Reconstruction 04 Hrs.

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.

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.

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

Suggested 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.

The Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Gonzales and Woods, "Digital Image Processing", Pearson Education, Third Edition, 2002.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", Cengage Engineering, Third 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, Third Edition, 2002.

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

Pre-requisite

1. Wave Theory and Radio Frequency Design

Course Objectives

1. To learn fundamental parameters of Antenna.
2. To learn about linear wire antenna elements and Antenna arrays.
3. To learn about Special types of Antennas.
4. To learn measurement procedures of Antenna parameters.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain and measure 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.	L3	Apply
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

Course Contents

Unit-I Antenna Fundamentals: 10 Hrs.

Review of Maxwells 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 08 Hrs.

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.

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 Microstrip Antenna: 08 Hrs.

Introduction, Feeding Techniques, Regular Shape MSAs (Rectangular, Circular, Equilateral Triangular), Design of Regular shape MSAs.

Unit-V **Aperture Antennas:** **06 Hrs.**

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(RCP23ELPC603)

List of Laboratory Experiments:

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 method.
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"*, John Wiley Sons, 3rd Edition, Hoboken, NJ, 2016.
2. G. Kumar, K. P. Ray,, *"Broadband Microstrip Antenna"*, Artech House,1st Edition, 2002.

Reference Books

1. R. E. Collin, *"Antennas and Radio Wave Propagation"*, International Student Edition, McGraw Hill, 4th Edition, 1985

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	Semester: VI
Power Electronics (RCP23ECPE601)		
Power Electronics Laboratory(RCP23ELPE601)		

Pre-requisite

1. Basic Electrical Engineering & Digital Electronics
2. Engineering Mathematics III
3. Electronics Circuit Design

Course Objectives

1. To develop the understanding of fundamental principles of power electronics. introduce mathematical modelling, time domain analysis & frequency domain analysis.
2. To disseminate various power electronic semiconductor devices and their characteristics
3. 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 and Design AC-DC & AC-AC converters.	L6	Create
CO4	Analyze and Design DC-DC & DC-AC converters.	L6	Create

Power Electronics (RCP23ECPE601)

Course Contents

Unit-I Power Semiconductor Devices 04 Hrs.

Principle of operation, constructional features and characteristics of: SCR, TRIAC, DIAC, GTO, MOSFET and IGBT.

Unit-II Triggering, Commutation and Protection 07 Hrs.

Basic Gate Drive circuits for SCR, TRIAC, MOSFET and IGBT, Methods of commutation of SCR, Methods of protection of SCR.

Unit-III AC-DC Converters 07 Hrs.

Uncontrolled half and full wave rectifiers with R and RL load, SCR controlled half and full wave rectifier with R and RL load. Power factor of the controlled rectifier. Effect of source and load inductances

Unit-IV -DC Converters 08 Hrs.

Buck, Boost and Buck-Boost converters, Flyback and Cúk converter, DC-DC converters with R and RL load.

Unit-V DC-AC Converters 08 Hrs.

Principle of operation and performance parameters, Voltage control of single phase inverters

Unit-VI AC-AC Converters 08 Hrs.

Principle of on-off and phase angle control; performance parameters, Single phase full-wave AC-AC converter with R and RL load

Power Electronics Laboratory (RCP23ELPE601)

List of Laboratory Experiments:

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 flyback converters
12. To study single phase DC to AC converters
13. To study AC to AC converters.

(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. N. Mohan, T. M. Undeland, W. P. Robbins, "Power Electronics:Converters Application and Design", John Wiley & Sons, USA, 2003.
2. M. H. Rashid, "Power Electronics: Circuits, Devices, and Applications", Pearson Education India, 2009.
3. P.S. Bhimbra, "Power Electronics", Khanna Publishers, 2012.

Reference Books

1. P.C. Sen, "Modern Power Electronics", S Chand publications, 2014.
2. Ramamurthy, "Thyristor & Their Applications", East-West Press, 2012.

Program: Electronics and Telecommunication Engineering	T.Y.B.Tech	Semester: VI
Digital VLSI design(RCP23ECPE602)		
Digital VLSI design Laboratory (RCP23ELPE602)		

Pre-requisite

1. Electronics Devices & Circuits
2. Digital System Design
3. Integrated Circuits

Course Objectives

1. To highlight the circuit design issues in the context of VLSI technology.
2. To provide understanding of VLSI circuit design using different design styles.
3. 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 08 Hrs.

MOSFET Scaling: Types of scaling, short channel effects. Layout: Lambda based design rules(CMOS), MOSFET capacitances.

Unit-II MOS Circuit Design Styles 10 Hrs.

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 09 Hrs.

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 09 Hrs.

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 06 Hrs.

Semi-custom Full custom design PLA PAL PROM FPGA PLD. Introduction to Verilog.

Digital VLSI design Laboratory(RCP23ELPE602)

List of Laboratory Experiments

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, 3rd Edition, 2012.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", SunSoft Press, 2nd Edition, 2003.

Reference Books:

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

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

Pre-requisite

1. Structured Programming using C

Course Objectives

1. To introduce operating system as a resource manager, its evolutions and fundamentals.
2. To understand the structure, functions and characteristics of computer system.
3. To analyze, evaluate and implement different policies for scheduling, deadlocks, memory management, synchronization, file management & I/O .
4. 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(RCP23ECPE603)

Course Contents

Unit-I Fundamental of Operating System (OS) 05 Hrs.

Definition, objectives, functions, evolution, services, types, and different views of OS Operating System as a resource manager, system calls, and shell, Monolithic systems, layered systems, client server model, monolithic kernel and Microkernel.

Unit-II Process Management 10 Hrs.

Process, process creation, process control block, process states, process state transition diagram, types of schedulers: preemptive and non- preemptive, types of scheduling algorithms, types of threads, multithreading models.

Unit-III Memory Management 10 Hrs.

Race condition, critical section, mutual exclusion, Deadlock Problem, deadlock characterization, deadlock prevention and deadlock avoidance deadlock detection and recovery, semaphores. Multiprogramming with fixed and variable partitions, memory allocation strategies, Logical and physical address space, paging and segmentation, Concept, performance of demand paging, page replacement algorithms.

Unit-IV File Management and Input Output Management 10 Hrs.

File Naming, File Structure, File Types, File Access, File Attributes, File Operations, Memory Mapped Files, Implementing Files, contiguous allocation, linked list allocation, indexed allocations, Single level directory system, Two level directory system, Hierarchical Directory System, Principles of Input/output H/W: I/O Devices, Device Controllers, Direct Memory Access, Principles of Input/output S/W: Goals Of I/O S/W, Interrupt Handler, Device Driver, Device Independent I/O Software, Disks :RAID levels, Disks Arm Scheduling Algorithms, Management of free blocks.

Unit-V Real Time Operating System (RTOS) 07 Hrs.

Introduction, Characteristics of real-time operating systems, Real Time task Scheduling, Modeling Timing constraints, Table-driven scheduling, Cyclic schedulers, Earliest Deadline First (EDF) scheduling, Rate Monotonic Algorithm. (RMA)

Operating Systems Laboratory (RCP23ELPE603)

List of Laboratory Experiments

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	Semester: VI
Big Data Analytics(RCP23ECPE604)		
Big Data Analytics Laboratory(RCP23ELPE604)		

Pre-requisite

1. Database Management System

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply Big Data analytics concepts and Hadoop components to analyze data characteristics, select suitable technologies, and understand Hadoop architecture.	L3	Apply
CO2	Apply NoSQL concepts and data architecture patterns to analyze Big Data using shared-nothing architectures, select appropriate distribution models, and perform basic operations using MongoDB.	L3	Apply
CO3	Analyze MapReduce execution and components to design efficient map, reduce, and combiner functions for implementing data-intensive algorithms such as word count, sorting, matrix-vector multiplication, and relational algebra operations.	L4	Analyze
CO4	Analyze big data using techniques such as nearest neighbor search, data stream mining, frequent itemset mining, recommendation systems, link analysis, and social network graph clustering to extract patterns, relationships, and actionable insights.	L4	Analyze
CO5	Evaluate and optimize Apache Spark RDD operations and transformations to design efficient distributed data processing tasks.	L5	Evaluate

Course Contents

Unit-I Introduction to Big Data Analytics & Hadoop 07 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 07 Hrs.

Introduction to NoSQL, NoSQL business drivers, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family stores, Document stores, NoSQL case studies, analyzing big data with a shared-nothing architecture, Choosing distribution models: master-slave versus peer-to-peer. Introduction to MongoDB, MongoDB commands.

Unit-III MapReduce 08 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, RelationalAlgebra 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 Itemset Mining: Market Basket Model- Applications, Association Rule,Confidence, Interest,Support, Apriori Algorithm :Pass1, Pass2 Recommendation Systems: Introduction, Collaborative-Filtering S y s t e m, 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, Interac-

tive operations on Spark RDD, RDD transformations, Execution of word count transformation.

Big Data Analytics Laboratory(RCP23ELPE604)

List of Laboratory Experiments:

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

    (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. 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	Semester: VI
Data Compression and Encryption(RCP23ECPE605)		
Data Compression and Encryption Laboratory(RCP23ELPE605)		

Pre-requisite

1. Mathematics for Telecommunication Engineering
2. Signals & Systems

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze and compare lossless text compression algorithms such as Huffman, Arithmetic, and Lempel–Ziv techniques based on compression ratio, complexity, and efficiency.	L4	Analyze
CO2	Evaluate image compression techniques including DPCM, JPEG, and JPEG 2000 by analyzing trade-offs between compression efficiency, image quality, and computational cost.	L5	Evaluate
CO3	Analyze audio and video compression standards such as MP3, MPEG-2, and H.261 with respect to bandwidth utilization, data rate, and quality of service.	L4	Analyze
CO4	Evaluate symmetric key cryptographic algorithms and key management mechanisms by assessing their security strength, performance, and resistance to cryptographic attacks.	L5	Evaluate
CO5	Design and evaluate secure communication systems using public key cryptography, digital signatures, and hash functions to ensure confidentiality, authentication, and integrity.	L6	Create
CO6	Design secure network communication models using protocols such as PGP, S/MIME, IDS, and X.509 to protect electronic transactions and emerging cryptocurrency systems.	L6	Create

Data Compression and Encryption(RCP23ECPE605)

Course Contents

Unit-I Text compression 10 Hrs.

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 06 Hrs.

Differential lossless compression DPCM, JPEG-LS, DCT, JPEG, JPEG 2000.

Unit-III Audio and Video Compression 05 Hrs.

Digital Audio, μ law and A law companding, MPEG-1 Audio layer (MP3 audio format), Digital Video, MPEG-2, H.261 encoder and decoder.

Unit-IV Symmetric key cryptography & Key management 08 Hrs.

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 08 Hrs.

Prime numbers, Fermat's 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 05 Hrs.

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:

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 belwo 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 Sayood , "Introduction to Data Compression", Elsevier, 5^{th} Edition, 2017.
2. William Stallings, "Cryptography and Network Security Principles and Practices", Pearson Education, 5^{th} Edition, 2020.
3. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill, 3^{rd} Edition, 2015

Reference Books

1. David Saloman, "Data Compression: The Complete Reference",4^{th} Edition, Springer, 2007.

2. Mark Nelson, Jean- Loup Gailly, "The Data Compression Book",2^{nd} Edition, BPB Publications,2014.

3. Atul Kahate, "Cryptography and Network Security", McGraw-Hill ,4^{th} Edition, 2019

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

Pre-requisite

1. Mathematics for Telecommunication Engineering

Course Objectives

1. Understanding basic principles of probability, hypothesis testing and correlation between data.
2. Apply the concepts of Data Analysis using Sampling theory.
3. 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.	L2	Understand
CO2	Perform data cleaning and transformations on a given dataset.	L3	Apply
CO3	Perform data modeling 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 08 Hrs.

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, relationship), 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 06 Hrs.

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.

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.

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 06 Hrs.

Curse of Dimensionality, Feature Selection: Univariate methods and Multivariate methods.

Data Analytics Laboratory (RCP23ELPE606)

List of Laboratory Experiments:

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", 6^{th} Edition, Wiley, 2019.
2. Ethem Alpaydin, "Introduction to Machine Learning", 4^{th} Edition, MIT Press, 2020.

Reference Books

1. Seymour Lipschut, "Probability", 3^{rd} Edition, McGraw-Hill, 2021.

2. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", 12^{th} Edition, Sultan Chand & Sons, 2020.

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

Pre-requisite

1. Microcontroller & Applications
2. Analog & Digital Communication

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain concepts, functional blocks, communication methodology related to IoT	L2	Understand
CO2	Describe and classify the architecture and core components of IoT systems.	L2	Understand
CO3	Implement sensor and actuator interfacing using Raspberry Pi for IoT-based applications.	L3	Apply
CO4	Analyze various methods of data acquisition, transmission, storage, and processing in IoT systems.	L4	Analyze
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 04 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 05 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 05 Hrs.

Data acquisition and storage, Data Handling and Analytics

Unit-VI Cloud Computing 08 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 Experiments

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 with the help of PIR sensor, buzzer and key-pad.(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. (Alarm gets disabled if correct keypad password is entered)

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. Madisetti ,"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	Third Year B.Tech	Semester: VI
Machine Learning & Applications (RCP23ECMD601)		
Machine Learning & Applications Laboratory(RCP23ELMD601)		

Pre-requisite

1. Mathematics for Telecommunication Engineering
2. Digital Signal Processing

Course Objectives

1. Introduce students to the fundamentals of machine learning (ML) techniques.
2. 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	Summarize 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	Analyze

Course Contents

Unit-I Linear Models for Regression 08 Hrs.

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 08 Hrs.

Classifying with k-Nearest Neighbors, Decision Trees, Naïve Bayes, Logistic regression, Least Squares for Classification.

Unit-III Non Linear Models-Neural Networks 08 Hrs.

Parameter Optimization, Gradient descent Optimization, Evaluation of error-function derivatives, A simple example, Efficiency of backpropagation.

Unit-IV Probabilistic models and Expectation Maximisation Algorithm Key management 08 Hrs.

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 Recognition Image Processing 10 Hrs.

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:

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 Naïve 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.

Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

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.	Semester: VI
Project Stage - I (RCP23IPEL601)		

Prerequisite: Analog Communication, Micro-controller & Applications-I and II .

Course Objective(s): To implement the solution as per the problem statement.

1. To develop the team building, writing, logical reasoning and management skills.
2. To provide the connections between the designs and concepts across different disciplinary boundaries.
3. To encourage students to become independent personnel, critical thinkers and life-long learners.

Course Outcomes:

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the problem statement and produce solution of the problem considering cultural, social, environmental and economic factors using appropriate tool and method.	L4	Analyse
CO2	Interpret project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Apply the ability to work in teams and manage to conduct the project development activity.	L3	Apply
CO4	Use different perspectives from relevant disciplines which help them to get internships, jobs, and admission for higher studies.	L3	Apply
CO5	Explain the project development in the form of technical writing, and interpret what constitutes plagiarism and the use of proper referencing styles.	L2	Understand

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 develop ment, 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 Con tinuous Assessment:

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

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.

Table 1: Log Book Format

Sr	Week (Start date:End date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Sheet

SN	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
1								

Table 3: Evaluation Sheet

SN	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	PCB/ hardware/ program-ming	Result Verification	Presen tation	Total
1								

Program: Electronics and Telecommunication Engineering	T.Y. B.Tech.	Semester: VI
Constitution of India (RCP23ICHSX07)		

Course Objectives

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

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply general knowledge and legal literacy and thereby take up competitive examinations.	L3	Apply
CO2	Explain features of the Indian Constitution.	L2	Understand
CO3	Discuss Fundamental Rights and Directive principles of state policy.	L2	Understand
CO4	Explain structure of the state executive and Judiciary.	L2	Understand
CO5	Discuss special provision for backward class, women and children.	L2	Understand
CO6	Discuss the role of integrity, ethics, and reliability in professional engineering practice as guided by constitutional values.	L2	Understand

Constitution of India (RCP23ICHSX07)
Course Contents

Unit-I Introduction to the Constitution of India 02 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 03 Hrs.

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

Unit-III State Executives 03 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 03 Hrs.

Special Provisions: 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 03 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