

B. Tech. (Electronics and Communication Engineering)
Semester III (Second Year)

Code		Category	Course Title	Hours/Week			Total	Credits	Marks		
Department	University			L	T	P			CIE	SEE	Total
EC 4301C	7-3-3-01R25	MA-BS	Complex variables, Probability & Statistics	3	0	0	3	3	40	60	100
EC 4302C	7-4-3-02R25	EC-PC	Network Analysis	3	0	0	3	3	40	60	100
EC 4303C	7-4-3-03R25	EC-PC	Signals, Systems and Stochastic Processes	3	0	0	3	3	40	60	100
EC 4304C	7-4-3-04R25	EC-PC	Electronic Circuit Analysis	3	0	0	3	3	40	60	100
EC 4305C	7-4-3-05R25	EC-PC	Digital Logic Design	3	0	0	3	3	40	60	100
EC 4306C	7-4-3-06R25	EC-PC	Electromagnetic Waves and Transmission Lines	3	0	0	3	3	40	60	100
EC 4307L	7-4-3-R25P1	EC-PC	Network Analysis and Simulation Lab	0	0	3	3	1.5	40	60	100
EC 4308L	7-4-3-R25P2	EC-PC	Electronic Devices and Circuits Lab	0	0	3	3	1.5	40	60	100
EC 4309S	7-4-3-R25S1	EC-SC	Entrepreneurship and Design Thinking	1	0	2	3	2	100	---	100
EC 4310M	7-0-3-R25M1	CE-MC	Environmental Science	2	0	0	2	0	100	---	100
TOTAL				21	-	8	29	23	520	480	1000
All interested students are advised to register for Minors degree or Honors degree at the end of this semester by submitting filled in registration form available from the Head of the Department /Chair person, Board of Studies (UG) of the parent department.											



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COMPLEX VARIABLES, PROBABILITY & STATISTICS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	3-0-0	7-3-3-01R25	EE,EC

Course Objectives:

1. This course aims at providing the student to acquire the knowledge on the calculus of Functions of complex variables.
2. To understand power series and expansion of analytic function, poles, singular points, Residue Theorem and its applications
3. To discuss the boundary value problems, one dimensional wave equation, heat equation And Laplace Equation
4. This course aims at providing the student with the knowledge on probability and random variables.
5. To acquaint the students with different types of binomial, Poisson, normal and other distributions.

UNIT – I

Complex analysis - I: Analytical functions - Cauchy-Riemann equations – Construction of Analytic functions- Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT - II

Complex analysis - II: Sequences, series, convergence tests, -Taylor's and Laurent's series - Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals

UNIT – III

Partial differential equations - First order linear partial differential equations – Lagrange's linear equation- first order non-linear partial differential equations by Charpit's method - Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

UNIT – IV

Probability- Introduction- axiomatic approach, - combinatorial probability -joint and conditional probability- Baye's theorem - stochastic process - Random variables - Discrete and Continuous distributions – expectation – variance.

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UNIT- V

Probability distributions: Binomial distribution-Poisson distribution- exponential distribution-normal distribution.

Text Books:

1. Grewal B S, Higher Engineering Mathematics, 42th Edition, Khanna Publications, 2007.
2. Mathematics-III by T.K.V.Iyenger, B. Krishna Gandhi et al, S. Chand & Company Ltd
3. Mathematical Methods by T.K.V.Iyenger, B. Krishna Gandhi et al, S. Chand & Company Ltd
4. T. K. V. Iyengar et al, Probability and Statistics 2nd Edition, S. Chand & Company Ltd, 2010
5. S P Gupta, Statistical Methods, 38th Edition, Sultan S. Chand & Sons Educational Publishers, 2009

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

1. After the completion of course, students will be able to understand the analyticity of complex functions and apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
2. Compute the residue of a function and use the Residue Theory to evaluate a contour integral
Or an integral over the real line.
3. Identify linear and Nonlinear PDE by different methods and apply Variables separable methods to solve boundary value problems and find the solution of one dimensional wave equation, heat equation and Laplace equation.
4. The concepts of probability and their applications and Evaluate discrete and continuous probability distributions.
5. Different types of distributions and their properties.

Mapping of Course Outcomes with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
CO1	3	3	3	3	3	1	1	1	1	2	1	3	1	3
CO2	3	3	3	3	3	1	1	1	1	2	1	3	1	3
CO3	3	2	2	2	3	1	1	1	1	2	1	3	1	3
CO4	3	2	3	3	3	1	2	1	1	2	1	3	1	3
CO5	3	2	3	3	3	1	2	1	1	2	1	3	1	3

1 – Slightly; 2 - Moderately; 3 – Substantially

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NETWORK ANALYSIS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	3-0-0	7-4-3-02R25	EC

Course Objectives

1. To understand the fundamental concepts and laws of electrical networks including Kirchhoff's laws and network topology.
2. To analyze DC and AC networks using node voltage, mesh current, and network theorem techniques.
3. To study transient response and steady-state behaviour of RL, RC, and RLC networks.
4. To analyze resonance, frequency response, and filter characteristics of electrical networks.
5. To apply network analysis techniques using mathematical tools and simulation software for modelling and performance evaluation.

UNIT-I

Network Theorems: Superposition Theorem– Reciprocity theorem -Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem- Millman's Theorem —Tellegen's Theorem – Compensation Theorem - Application of these Theorems for D.C. circuits and A.C. circuits, Introduction to Three Phase Circuits.

UNIT-II

Resonance: Series and Parallel Resonance – Resonant frequency, Half power frequencies, bandwidth and Quality Factor.

Locus diagrams: Current locus diagrams of RL and RC series circuits and two branch parallel circuits

UNIT-III

Transient Analysis: Time domain analysis of RL, RC, and RLC circuits for D.C. and sinusoidal excitations – Determination of initial conditions – Concept of time constant – Transient response of RL, RC, and RLC circuits using Laplace Transform techniques.

UNIT-IV

Network Functions: One-port and Two-port networks – Driving point and transfer functions of networks –Concept of complex frequency, poles and zeros – Time domain response from pole-zero diagram – Restrictions on pole-zero locations.



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UNIT-V

Two-port Network Parameters: Open circuit impedance and short circuit admittance parameters – Hybrid and inverse-hybrid parameters – Transmission and inverse transmission parameters – Inter relationships between parameter sets – Series, Parallel, and Cascade connection of two-ports – Conditions for reciprocity and symmetry of two-port networks.

Text/Reference Books:

1. Sudhakar and Shyammohan: Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh: Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co
4. M. E. Van Valkenburg; “Network analysis”; Pearson Education, Third Revised Edition

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Apply network theorems to analyze D.C. and A.C. circuits.
2. Analyse resonance and locus diagrams in A.C. circuits.
3. Analyse transient response of RL, RC, and RLC circuits using time-domain and Laplace methods.
4. Determine network functions and analyze pole–zero behaviour of networks.
5. Analyse two-port networks using various parameters and interconnections.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	-	2	2	-	-	-	-	-	-	-	3	3
CO4	3	3	-	2	-	-	-	-	-	-	-	-	3	3
CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	3


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SIGNALS, SYSTEMS AND STOCHASTIC PROCESSES

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	3-0-0	7-4-3-03R25	EC

Course Objectives:

1. Understanding the basics of signals and systems required for ECE courses.
2. To teach concepts of signals and systems and its analysis using different transform techniques.
3. To provide basic understanding of random processes which is essential for the random signals and systems encountered in communications and signal processing areas.

UNIT I**Introduction to Signals and Systems:**

Definition and classification of signals and systems, Basic operations on signals, Elementary signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time- Invariant Systems - Discrete-Time LTI Systems, Convolution Sum, Continuous-Time LTI Systems Convolution Integral. Causal LTI Systems Described by Differential and Difference Equations

Signal Analysis:

Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions

UNIT II**Behavior of continuous time LTI systems:**

Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Sampling:

Sampling Theorem, Reconstruction of a Signal from its Samples Using Interpolation, types of sampling-natural sampling, flat- top sampling and impulse sampling, Effect of under sampling - Aliasing.

UNIT III**Convolution and Correlation:**

Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Properties, Energy spectral density, Power spectral density, Relation between convolution and correlation.



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System Analysis using Laplace and z-Transforms:

Laplace Transform - Region of Convergence – Relation between Laplace and Fourier Transform, Inverse Laplace Transform, Properties, Analysis and Characterization of LTI Systems Using Laplace Transform, Z- Transform -Region of Convergence - Properties, Inverse z-Transform, Analysis and Characterization of LTI Systems Using z-Transforms.

UNIT IV

Operations on Single and Multiple Random Variables: Expected Value of a Function of Random Variables, moments of random variable, Characteristic functions of a random variable, Vector Random Variables, Joint distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, functions of one and two random variables, Conditional Distribution and Density, Methods of defining Conditioning Event, Conditional Density, Properties. Statistical Independence, Sum of Two or Several Random Variables, Markov, Chebyshev and Chernoff bounds. Limit theorems: Strong and weak laws of large numbers, Central Limit Theorem (Proof not expected).

UNIT V

Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict Sense Stationarity, Time Averages and Ergodicity, Cross-Correlation Functions and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.

Random Processes – Spectral Characteristics: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross- Power Density Spectrum of Input and Output.

Textbooks:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, 2nd Edition PHI, 2009.
2. Peyton Z. Peebles, “Probability, Random Variables & Random Signal Principles”, 4th Edition, TMH, 2002.


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Reference Books:

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
2. Henry Stark and John W. Woods, “ and Random Processes for Engineers 4th Edition, PHI, 2012.
3. Matthew Sadiku and Warsame H. Ali, “Signals and Systems A primer with MATLAB”, CRC Press, 2016.

Course Outcomes: After completion of this course, the student will be able to:

1. Analyse and classify signals and systems and evaluate LTI systems using convolution methods.
2. Analyse continuous-time LTI system behaviour, bandwidth concepts, and sampling principles.
3. Apply convolution, correlation, Laplace, and z-transform techniques for system analysis.
4. Understand the Operations on single and multiple random variables.
5. Understand and analyse random processes temporal characteristics and spectral characteristics and system responses using power spectral density concepts.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	2	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	1	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	1	2	3
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	3



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ELECTRONIC CIRCUIT ANALYSIS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	3-0-0	7-4-3-04R25	EC

Course Objectives

1. To understand the fundamental concepts and characteristics of General amplifiers, BJT Amplifiers
2. To analyze FET amplifier configurations under low and high frequency conditions.
3. To study the principles of feedback and oscillator circuits and their performance characteristics.
4. To examine the operation and efficiency of different power amplifier circuits.
5. To understand the working of differential amplifiers and operational amplifiers and their applications.

UNIT-I

General Amplifiers Characteristics: Concept of Amplifier, Voltage gain, Current gain, Power gain, Input and Output resistances, Conversion efficiency, Frequency response, Bandwidth, Distortion,

BJT Amplifiers: Small signal low frequency model of the transistor, Analysis of CE, CB and CC amplifiers, Approximate model analysis, Effects of coupling and bypass capacitors on low frequency response, Hybrid-II model at high frequencies, Calculation of High-Frequency parameters in terms of Low Frequency parameters, CE short circuit gain, CE current gain with resistive load

UNIT-II

FET Amplifiers: Small signal model, Analysis of CS, CD and CG amplifiers, comparison of performance of the three configurations, High frequency FET circuits, CS amplifier at high frequencies, CD amplifier at high frequencies.

Multistage Amplifiers: Types of coupling, Choice of amplifier configuration, overall voltage gain and Bandwidth of n-stage amplifier, Darlington and Bootstrap circuits

UNIT-III

Feedback amplifiers: Feedback concept, Classification, Effects of negative feedback on gain, Stability, Noise, Distortion, Bandwidth, input resistance and output resistance.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Crystal oscillators



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UNIT-IV

Power Amplifiers: Series-Fed Class-A power amplifiers, Transformer coupled class-A power amplifiers, harmonic distortion, Push-pull amplifiers, Class-B amplifiers, Class-AB operation, Complementary symmetry Push-Pull class-B Power amplifiers, Cross-over distortion

UNIT-V

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR, circuits to improve CMRR, transfer characteristics.

Operational Amplifier: Ideal op-amp characteristics, Op-amp internal circuit, examples of IC Op-Amps, DC and AC characteristics, Inverting and non-inverting modes of operation, voltage follower.

Text/Reference Books:

1. Millman and Halkias, "Integrated Electronics", McGraw-Hill Co
2. Mottershed, "Electronic devices and circuits", PHI
3. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
4. Salivahanan, "Electronic Devices and circuits", TMH.
5. David A. Bell, "Electronic Devices and circuits", PHI
6. D.RoyChoudary, ShailBala Jain, "Linear Integrated circuits", New Age International publishers, 2018

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Design and analyze various amplifier circuits.
2. Develop the Ability to understand the design and working of FET and multistage amplifiers.
3. Ability to understand the concept of feedback amplifiers and Oscillators.
4. Analyze different types of power amplifiers.
5. Understand the functioning of OP-AMP and design OP-AMP based circuits

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	1	1	1	1	1	1	3	3	1
CO2	3	3	2	2	3	1	1	1	1	1	1	3	3	1
CO3	3	3	2	2	3	1	1	1	1	1	1	3	3	1
CO4	3	3	2	2	3	1	1	1	1	1	1	3	3	1
CO5	3	3	2	2	3	1	1	1	1	1	1	3	3	1

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DIGITAL LOGIC DESIGN

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	3-0-0	7-4-3-05R25	EC

Course Objectives:

1. To understand the fundamentals of number systems and Boolean algebra.
2. To analyze and design basic logic gates and combinational circuits
3. To design and analyze sequential circuits such as flip-flops, registers, and counter
4. To simplify and optimize digital circuits using Karnaugh maps and Boolean techniques.
5. To apply digital logic principles to design efficient and reliable digital systems

UNIT I

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion

UNIT II

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT III

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudorandom Binary Sequence generator.

UNIT IV

Clock generation Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices,

UNIT V

VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.



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Text / Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd Edition, 2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989 Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes: At the end of this course students will demonstrate the ability to

1. Outline binary arithmetic operations and optimize Boolean functions using Karnaugh
2. Design and analyse combinational logic circuits
3. Design and analyse Sequential logic circuits
4. Extend the logic design techniques for ECL, TTL, CMOS methodologies and PLDs.
5. Understand the VLSI Design flow and VHDL modules for implementing combinational and Sequential circuits

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	-	-	1	2	2	2
CO2	3	3	2	2	1	-	-	-	-	-	1	2	2	2
CO3	3	3	2	2	1	-	-	-	-	-	1	2	2	2
CO4	2	3	2	2	1	-	-	-	-	-	1	1	2	2
CO5	2	3	3	3	1	-	-	-	-	-	1	1	2	2



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ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	3-0-0	7-4-3-06R25	EC

Course Objectives

1. To understand the fundamentals of electromagnetic field theory
2. To understand the fundamentals of magneto static fields.
3. To analyze maxwell's equations in static fields, time varying fields, time harmonic fields and study uniform plane wave characteristics
4. To understand the principles and characteristics of transmission lines, including impedance, reflection coefficient, and standing waves.
5. To apply transmission line concepts for practical applications such as impedance matching and power transfer.

UNIT-I

Electrostatic Fields: Coulomb's law, Electric field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law, Applications of Gauss's law, Electric scalar potential, Relation between E and V, Energy stored in electrostatic field, Electrostatic Boundary conditions, Capacitances.

UNIT-II

Magnetostatic fields: Biot-Savart's law, Magnetic field intensity, Magnetic fields due to continuous current distributions, Magnetic flux density, Ampere's circuital law, Applications of Ampere's circuital law, Magnetic vector potential, Relation between B and A, Energy stored in Magnetostatic field, Magnetostatic Boundary conditions, Inductances.

UNIT-III

Time-Varying EM Fields: Faraday's Law, Transformer EMF, Displacement current, Maxwell's Equations in Point Form and in Integral Form, Phasor notation for fields, Maxwell's Equations in time harmonic form. Introduction to waves: Uniform plane wave, Wave equations, Derivation for γ , solutions for free space- conditions, Derivation for α and β , Derivation for η .

UNIT-IV

EM waves in a homogeneous medium: Wave propagation in lossy dielectrics, Wave propagation in lossless dielectrics, Wave propagation in free space, Wave propagation in good conductors, Skin Depth, Skin Resistance, Polarization, Power, Poynting theorem and Poynting vector.



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EM waves in a heterogeneous medium: Reflection of a plane wave at normal incidence: transmission coefficient, reflection coefficient, Reflection of a plane wave at oblique incidence: transmission coefficient, reflection coefficient and Brewster angle in both parallel and perpendicular polarizations.

UNIT-V

Transmission Lines: Transmission line parameters, Transmission line Equations, Input impedance, Reflection coefficient, VSWR and Power of Transmission line, Smith Chart.

Applications of transmission lines: Load matching measurement, Load impedance measurement.

Text/Reference Books:

1. Mathew N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", Oxford University Press.
2. William H. Hayt, John A. Buck, "Engineering Electromagnetics", 8th Edition, McGraw-Hill, 2010.
3. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India.
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India Education, 2008
David K. Cheng, Field and Wave Electromagnetics, Pearson, second edition.

Course Outcomes: At the end of this course students will have the ability to

1. Solve electric field intensity and electric flux density in Electrostatic fields.
2. Solve magnetic field intensity and magnetic flux density in Magnetostatic fields.
3. Analyze Maxwell's equations in static fields, time varying fields, time harmonic fields and study uniform plane wave characteristics.
4. Compute reflection coefficient and transmission coefficient of waves at media interface.
5. Understand characteristics of high frequency transmission lines and its applications

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	-	2	-	-	-	-	-	3	1	2
CO2	3	-	3	-	-	2	-	-	-	-	-	3	1	2
CO3	3	-	3	-	-	2	-	-	-	-	-	3	1	3
CO4	3	-	3	-	-	2	-	-	-	-	-	3	1	3
CO5	3	3	3	-	-	2	-	-	-	-	-	3	1	3


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NETWORK ANALYSIS AND SIMULATION LAB

Credits: 1.5**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
III	0-0-3	7-4-3-R25P1	EC

Course Objectives

1. To understand and verify the fundamental laws and theorems of electrical networks such as Kirchhoff's laws, Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems.
2. To analyze the behaviour of DC and AC networks using network analysis techniques and validate the results through simulation tools.
3. To study the transient response of RL, RC, and RLC circuits and understand their time-domain characteristics.
4. To analyze resonance and frequency response characteristics of RLC networks and filters using simulation.
5. To use circuit simulation software effectively for modelling, analyzing, and validating electrical networks and system behaviour.

List of Experiments

1. Verification of KCL and KVL
2. Verification of Superposition & Reciprocity Theorem
3. Verification of Thevenin's and Norton's Theorem
4. Determination of Z, Y, Transmission and Hybrid Parameters of a T-Network
5. Measurement of Inductance
6. Locus Diagrams of RL and RC Series Circuits
7. Verification of mesh and nodal analysis for electrical circuits
8. Verification of the Maximum Power Transfer Theorem
9. Study of DC Transient Response in RL, RC, and RLC Circuits
10. Study of Series Resonance in an RLC Circuit
11. Determination of Z, Y, Transmission and Hybrid Parameters of a π (Pi) Network



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ELECTRONIC DEVICES AND CIRCUITS LAB**Credits: 1.5****Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
III	0-0-3	7-4-3-R25P2	EC

Course Objectives

1. To understand and experimentally verify the characteristics of electronic devices such as diodes, BJTs, and FETs used in electronic circuits.
2. To analyze the operation of basic electronic circuits including rectifiers, amplifiers, and biasing circuits through practical experimentation.
3. To study the performance of amplifier circuits and evaluate parameters such as gain, bandwidth, and frequency response.
4. To understand the behaviour of switching and oscillatory circuits and their applications in electronic systems.
5. To develop hands-on skills in using electronic laboratory instruments and simulation tools for circuit analysis, testing, and validation.

Hands-on experiments related to the course contents Electronic Devices Laboratory**List of Experiments:**

1. P-N Junction Diode Characteristics
2. Zener Diode Characteristics
3. Verify various clipping and clamper circuits using PN junction diode and draw the Suitable graphs.
4. Half Wave Rectifiers (without and with filter)
5. Full Wave Rectifiers (without and with filter)
6. CB Characteristics
7. CE Characteristics
8. CC Characteristics
9. FET Characteristics
10. BJT Biasing
11. SCR
12. UJT Characteristics
13. LDR Characteristics
14. LED characteristics
15. Photodiode characteristics
16. Phototransistor characteristics.

Some of the experiments can be done using any Simulation Software.



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Course Outcomes: After completion of the course student will be able to:

1. Plot and analyze the V–I characteristics of basic electronic devices
2. Study and verify the operation of rectifier circuits (half-wave and full-wave) with and without filters and analyze their performance.
3. Design, construct, and test clipping and clamping circuits using PN junction diodes and interpret the output waveforms.
4. Analyze the input and output characteristics of BJT configurations (CB, CE, and CC) and FET characteristics for different operating conditions.
5. Implement and test biasing circuits for BJTs and also learned the simulation software to perform experiments, record observations, and interpret experimental results

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	3	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	3	-	-	-	-	3	2
CO3	3	2	3	2	-	-	-	3	-	-	-	-	3	2
CO4	3	3	2	2	2	-	-	3	-	-	-	-	3	2
CO5	3	2	2	2	2	-	-	3	-	-	-	-	3	2



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ENTREPRENEURSHIP AND DESIGN THINKING

Credits: 2**Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
III	1-0-2	7-4-3-R25S1	EC

Course Objectives:

1. Identify entrepreneurial opportunities and generate viable business ideas using design principles.
2. Apply the design thinking process (empathize, define, ideate, prototype) to solve real-world problems.
3. Differentiate between creativity and innovation and evaluate the role of innovation in organizations.
4. Design basic products by defining problems, setting specifications, and developing product strategies.
5. Apply design thinking concepts to business processes, start-ups, and business model development.

UNIT-I**Introduction to Entrepreneurship and Design Thinking**

What is an idea, how to generate an idea, basic requirements to start an enterprise/start-up. Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry. Activity: Form into groups and discuss about the requirements to start a business

UNIT-II**Design Thinking Process**

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram/flow chart etc. Every student should explain about product development.

UNIT-III**Innovation**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. **Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.



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UNIT-IV**Product Design**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. **Activity:** Importance of modeling, how to set specifications, Explaining their own product design.

UNIT-V**Design Thinking in Business Processes**

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes. **Activity:** How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Change by design, Tim Brown, Harper Bollins (2009)
2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

Reference Books:

1. Design Thinking in the Classroom by David Lee, Ulysses press
2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design- William lidwell, kritinaholden, Jill butter.
4. The era of open innovation – chesbrough.H

Course Outcomes:

1. Identify entrepreneurial opportunities and generate viable business ideas using design principles.
2. Apply the design thinking process (empathize, define, ideate, prototype) to solve real-world problems.
3. Differentiate between creativity and innovation and evaluate the role of innovation in organizations.
4. Design basic products by defining problems, setting specifications, and developing product strategies
5. Apply design thinking concepts to business processes, start-ups, and business model development

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	2	-	3	-	2	3	1	-	-
CO2	2	3	3	2	-	-	-	3	-	2	-	1	-	-
CO3	2	2	2	-	-	2	-	3	-	2	-	1	-	-
CO4	2	3	3	-	-	-	-	3	-	2	-	1	-	-
CO5	2	3	3	-	-	2	-	3	-	2	3	2	-	-

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ENVIRONMENTAL SCIENCE

Credits: 0**Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
III	2-0-0	7-0-3-R25M1	EC

Course Educational Objectives(CEOs):

1. Introduce the scope and importance of environmental resources and their sources.
2. Impart knowledge on Ecosystem and Biodiversity.
3. Impart knowledge on causes and consequences of Environmental pollution its Global effects.
4. Familiarize with environmental issues and their management.
5. Outline different social issues and the guidelines formulated for protection of environment.

UNIT I

Environmental Studies and Natural Resources

Definition, Scope and importance of Environment, Environmental studies, Need for public awareness

Components of Environment- Atmosphere, Hydrosphere, Lithosphere.

Renewable and Non Renewable Resources and associated problems

Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.

Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Land resources: Land as a resource, land degradation, Man induced landslides, soil erosion and desertification.

Mineral resources: Use and overexploitation, Environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, Case studies.

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

Role of an individual in conservation of natural resources.

UNIT II

Ecosystem and Biodiversity

Ecosystem - Concept of an ecosystem.

Structure and functions of an ecosystem.

Producers, consumers and decomposers.



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Energy flow in the ecosystem.

Ecological succession.

Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem.

(a) Forest ecosystem. (b) Grassland ecosystem

(c) Desert ecosystem. (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation:

Definition, genetic species and ecosystem diversity.

Biogeographically classification of India.

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

Biodiversity at global, National and local levels.

India as a mega-diversity nation.

Hot-spots of biodiversity.

Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts.

Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT – III

Environmental pollution and Global Effects

Definition, Causes, Effects, and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies.

Disaster management: Floods, earthquakes, cyclone, landslides, Tsunami.

Climate change-Global warming, Acid rain, Ozone depletion.

UNIT – IV

Environment Issues and Management

Environment and Human health – Epidemic diseases, HIV/AIDS, Aviation Flue, Water Borne Diseases.

Environmental Impact Assessment, Sustainable Development, Clean Production and Clean Development Mechanisms

Environment Legislation: Environmental Protection Act, Water Act, Air Act, Wild Life Protection Act, Forest Conservation Act, Public Liability & Insurance Act, Issues involved in Enforcement of Environmental legislation.

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UNIT – V**Social Issues and the Environment**

Population growth, Population Explosion, Population Control, Women and Child welfare.

Urbanization, Industrialization, Development projects, Resettlement and Rehabilitation of people – Problems concerned, Case studies.

Consumerism and Waste Products Conservation, Public Awareness, Water Conservation, Rain water harvesting, watershed management, Wasteland reclamation, Human Rights, Value education, Environmental ethics- Issues and possible solution.

Role of information Technology in Environment and Human Health.

Text Books / Reference Books :

1. AnubhaKaushik& C P Kaushik, Environmental studies, New age International Publishers, 2008
2. Benny Joseph, Environmental studies, Tata McGraw-Hill Publishers, 2005
3. M Chandra Sekhar, Environmental Science, Hi-Tech Publishers, 2004
4. Keerthinarayana and Daniel Yesudian, Principles of Environmental Sciences and Engineering , Hi-Tech Publishers, 2005
5. AmalK.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000
6. SanthoshkumarGarg,RajeshawriGarg and RajniGarg, Ecological and Environmental studies, Khanna publishers, 2006
7. Gilbert M, Introduction to Environmental Engineering and Science, Masters Publication by Prentice –Hall of India Private Ltd., 1991
8. William P Cunningham and Mary Ann Cunningham, Principles of Environmental Science, Tata McGraw Hill Publishing Co.Ltd, 2002

Course Outcomes(Cos):

At the end of the course, students will be able to

1. Acquire knowledge in diverse components of environment and natural resources.
2. Understand ecosystem and biodiversity and its conservation methods.
3. Identify and resolve the issues related to sources of different types of pollution and its global effects
4. Provide solutions to individuals, industries and government for sustainable development of natural resources
5. Apply environmental ethics in resolving social issues for protection of diversified ecosystems.


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PO& PSO /CO	PO(1)	PO(2)	PO(3)	PO(4)	PO(5)	PO(6)	PO(7)	PO(8)	PO(9)	PO(10)	PO(11)	PO(12)	PSO (1)	PSO(2)
CO1						3		3	2	1	2	3	3	2
CO2								3	2	1	2	3	3	2
CO3								3	2				3	2
CO4								3	2				3	1
CO5								3	2				3	1

1 - Slightly; 2 - Moderately; 3 – Substantially



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B. Tech. (Electronics and Communication Engineering)
Semester IV (Second Year)

Code		Category	Course Title	Hours/Week			Total	Credits	Marks		
Department	University			L	T	P			CIE	SEE	Total
EC 4401C	7-0-4-01R25	MS-HS	Managerial Economics and Financial Accountancy	3	0	0	3	3	40	60	100
EC 4402C	7-4-4-02R25	CS-ES	Linear Control Systems	3	0	0	3	3	40	60	100
EC 4403C	7-4-4-03R25	EC-PC	Analog Communications	3	0	0	3	3	40	60	100
EC 4404C	7-4-4-04R25	EC-PC	IC Applications	3	0	0	3	3	40	60	100
EC 4405C	7-4-4-05R25	EC-PC	Microprocessors and Microcontrollers	3	0	0	3	3	40	60	100
EC 4406L	7-4-4-R25P1	EC-PC	Digital Logic Design Lab	0	0	3	3	1.5	40	60	100
EC 4407L	7-4-4-R25P2	EC-PC	Electronic Circuit Analysis Lab	0	0	3	3	1.5	40	60	100
EC 4408S	7-4-4-R25S1	EC-SC	Python Programming	1	0	2	3	2	100	0	100
EC 4409M	7-0-4-R25M1	EC-MC	Constitution of India	2	0	0	2	0	100	0	100
EC 4410N		EC-NG	NSS/ NCC/ NSO Activities	0	0	0	0	0	0	0	0
TOTAL				18	0	8	26	20	480	420	900

All students shall mandatorily register for NCC/NSO/NSS and complete 60 hours of activities beginning from the 1st semester but to be completed before 4th semester in one of these three options to earn **Non-graded (NG) Credits** as core requirement. Grade shall be awarded as Satisfactory or Unsatisfactory by the concerned HoD on the basis of participation, attendance, performance and behaviour. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

All interested students shall **register for Minors degree or Honors degree** just before or at the time of commencement of this semester by submitting filled in registration form available from the Head of the Department /Chair person, Board of Studies (UG) of the parent department.

Students shall undergo **Community Service Project (CSP)** for a duration of **six to eight (6-8) weeks** during the summer vacation by completing **45 – 60** hours of work with at least **75%** attendance, to be evaluated and reflected in 5th semester.



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MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTANCY

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	3-0-0	7-0-4-01R25	EC

COURSE DESCRIPTION

The objective of the Managerial Economics and Financial Accountancy is to equip students with the tools to make sound business and organisational decisions by analysing economic principles and financial data.

Managerial Economics objectives

1. Decision-making: To enable managers make optimal decisions to maximize a firm's profitability and success by integrating economic theory with business practices.
2. Analysis: To help in the analysis of business situations by providing insights into demand, supply, production functions and costs.
3. Problem-solving: To provide the tools to find optimal solutions for business problems such as those related to pricing, production, capital management, and profit planning.
4. Economic Concepts: To develop understanding of concepts like consumer behaviour, production and cost analysis and market structures.

Financial Accountancy objectives

5. Financial Analysis: To introduce students to financial accounting and analysis techniques, including the use of ratios like liquidity, activity, and profitability.
6. Historical Reporting: To understand how financial accounting records and reports on past performance through final accounts (income statement, balance sheet).
7. Financial Health Assessment: To provide a method for analysing and interpreting financial statements to understand a company's financial position and performance.
8. Informed Decisions: While primarily historical, the objective is to provide the information necessary for management and external stakeholders like investors to make informed decisions, even if it's for future forecasting.


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Detailed Syllabus

Unit -I

Managerial Economics: Definition, Characteristics and Scope – Basic economic tools in Managerial Economics. Managerial Economics and its relation with other subjects – Demand and Supply: Concept and Analysis – Time value of money, Cash flow and Time Diagrams – Choosing among alternative investment proposals: Methods of Economic analysis (Pay Back, ARR, NPV, IRR and B/C ratio)

Unit -II

Depreciation and methods of calculating depreciation (Straight line, Sum of the years digit method, Declining balance method, Annuity method, Sinking fund method) – National income accounting, Methods of estimation, Various concepts of National Income, Significance of National income Estimation and limitations.

Unit -III

Types of Industrial Organization: Characteristics of Industrial organization, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, State/Public Enterprises and their types – The Business cycles and their relevance to decision making – Inflation: Definition, Process of inflation and measure of controlling inflation – New Economic Policy 1991 (Industrial Policy, Trade Policy, Fiscal Policy). It's Impact on Industry.

Unit -IV

Accounting Principles, procedure, Double entry system, Journal, Ledger, Trial balance, Cashbook – Preparation of Trading account and Profit and Loss account, Balance sheet.

Unit –V

Cost Accounting: Introduction, Classification of costs, Methods of costing, Techniques of costing – Cost sheet and preparation of cost sheet – Break-even Analysis: Meaning, its application and Limitation.

Course Outcomes: After the completion of the course the student will be able to;

- CO1** Understand the concepts of financial management and smart investment.
- CO2** Identify various cost elements of the product and its effect on decision making.
- CO3** Understand Economic and regulatory environment of the business and its impact on enterprises.
- CO4** Prepare the Accounting records and interpret the data for Managerial Decisions.
- CO5** Identify various cost elements of the product and its effect on financial decision making.



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Mapping of Course outcomes with program outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	2	1	1	2	1	3
CO2	3	3	2	2	1	2	2	1	1	2	1	3
CO3	3	2	1	1	1	1	1	1	1	2	1	3
CO4	3	2	2	1	1	1	1	1	1	2	1	3
CO5	3	3	3	2	2	1	1	1	1	2	1	3

Text Books

1. Gupta, G.S. (2018), Managerial Economics (2e), McGraw Hill Education (India) Pvt. Ltd., Chennai.
2. Dewett. K.K. (2006), Modern Economic Theory, Sultan Chand and Co., New Delhi.
3. Agarwal A.N. (2019), Indian Economy, New Age International Pvt. Ltd., New Delhi.
4. Jain and Narang (2011), Accounting Part-I, Kalyani Publishers, New Delhi.
5. Arora, M.N. (2012), Cost Accounting: Principles and Practice (12e), Vikas Publication, New Delhi.

Reference Books

1. Henry Malcom Steiner (1996), Engineering Economics Principles (2e), McGraw Hill Education.
2. Leland Blank and Anthony Tarquin (2012), Engineering Economy (7e), McGraw Hill, New York.



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LINEAR CONTROL SYSTEMS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	3-0-0	7-4- 4-02R25	EC

COURSE OBJECTIVES:

1. Introduce the basic principles and applications of control systems.
2. To understand the steady-state behaviour of systems and analyze time-invariant systems in the time domain.
3. Understand different aspects of stability analysis of systems in frequency domain.
4. To understand PI, PD, and PID controller and compensator design for improving system performance.
5. Understand the concept of state space, controllability and observability.

Unit-I

Introduction to control problem:

System Representation, Classification of systems, Feedback Control, Benefits of Feedback -Open-Loop and Closed- loop systems, Advantages and Disadvantages of control systems, Industrial Control examples.

Mathematical models of physical systems: Electrical, Mechanical and Electro-Mechanical, Transfer function models of linear time-invariant systems. Block diagram algebra, Reduction techniques and Signal flow graph.

Unit-II

Time Response Analysis:

Standard test signals, Time response of first and second order systems for standard test inputs. Design specifications for second-order systems based on the time-response, Steady state errors and error constants, Performance specifications in time- domain error, Static and Generalized error constants, Concept of stability, Routh-Hurwitz Criteria, Root-Locus technique, Construction of Root-loci

Unit-III

Frequency-response analysis:

Introduction to Frequency domain specifications -Relationship between time and frequency response, Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Relative stability using Nyquist criterion – gain and phase margin.



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Unit-IV**Introduction to Controller Design:**

Compensation & their realization in time & frequency domain, Introduction to controllers (PI, PD, PID), Need for Lead and Lag compensators, Comparison of controllers and compensators, Problems.

Unit-V**State variable Analysis:**

Concepts of state, state variables, State space model for linear continuous time functions, Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability.

Text/Reference Books:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, Seventh edition, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, second edition, 1991.
4. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.
5. K. L. Chung

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Summarize the basic principles and applications of control systems.
2. Understand the time response and steady state response of the systems.
3. Analyze different aspects of stability analysis of systems in frequency domain.
4. Design and apply PI, PD, PID controllers and compensators to improve system performance.
5. Understand the concept of state space, controllability and observability.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2	-	1	-	-	-	2	-	3	3
CO2	3	3	3	1	2	-	1	-	-	-	2	-	3	3
CO3	3	3	2	1	2	-	1	-	-	-	2	-	3	3
CO4	3	3	2	1	2	-	1	-	-	-	2	-	3	3
CO5	3	3	2	1	2	-	1	-	-	-	2	-	3	3

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ANALOG COMMUNICATIONS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	3-0-0	7-4-4-03R25	EC

Course Description: This course gives concepts of Different Analog communications which they need for their experiments and research.

Course Objectives:

1. To understand the basic elements of communication systems and to study amplitude modulation schemes
2. To analyze angle modulation techniques
3. To understand the effects of noise in communication systems
4. To study radio receiver architectures and analog pulse modulation schemes
5. To apply information theory concepts

Unit – I

Introduction: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.

Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM), Illustrative Problems.

UNIT-II

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle modulation- Frequency Modulation & Phase modulation : Bandwidth of angle modulated waves, Narrow band frequency modulation (NBFM) and Wide band FM (WBFM), Verification of Frequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis, & De-emphasis filters, FM Capture Effect, Illustrative Problems.



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UNIT-III

Noise in Communication Systems: Thermal noise, Time domain representation of narrowband noise, filtered white noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSBSC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

UNIT-IV

Radio Receivers: Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity Analog Pulse Modulation Schemes: Sampling theorem, Nyquist rate, Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

UNIT-V

Information Theory: Introduction, Information and Entropy, and its properties, source coding Theorem, Data Compaction – Prefix coding, Huffman coding, Discrete Memory less channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems.

Text Books:

1. B. P. Lathi, “Modern Digital and Analog Communication Systems,” Oxford Univ. press, 3rd Edition, 2006.
2. Simon Haykin, “Communication Systems,” by John Wiley & Sons, 3rd Edition, 2010.
3. Sham Shanmugam, “Digital and Analog Communication Systems”, Wiley-India edition, 2006

REFERENCES:

1. Bruce Carlson, & Paul B. Crilly, “Communication Systems – An Introduction to Signals & Noise in Electrical Communication”, McGraw-Hill International Edition, 5th Edition, 2010.
2. Herbert Taub & Donald L Schilling, “Principles of Communication Systems”, Tata McGraw- Hill, 3rd Edition, 2009.



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3. . R.E. Ziemer& W.H. Tranter, “Principles of Communication-Systems Modulation & Noise”, Jaico Publishing House, 5th edition, 2001.
4. George Kennedy and Bernard Davis, “Electronics & Communication System”, TMH, 2004.

Course outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the concepts of various Amplitude modulation schemes
2. Understand the Angle and Pulse Modulation schemes and information theory with random processes and to solve problems in analog and pulse modulation schemes
3. Analysis of analog communication system in the presence of noise.
4. Compare and contrast design issues, advantages, disadvantages and limitations of various modulation schemes in analog communication systems.
5. Solve basic communication problems & calculate information rate and channel capacity of a discrete communication channel

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	--	--	--	1	--	--	--	--	--	--	3	1	--
CO2	3	1	2	--	2	2	--	1	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	1	--	--	2	2	1	--
CO4	2	2	2	--	1	--	--	--	--	--	--	2	--	1
CO5	2	2	2	2	2									2

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IC APPLICATIONS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	3-0-0	7-4-4-04R25	EC

Course Description: The main aim of this course is to teach the linear and non-linear applications of operational amplifiers (741). Students are made familiar with theory and applications of 555 timers.

Course Objectives:

1. To understand and analyze operational amplifier applications.
2. To study comparators and waveform generation circuits using op-amps and ICs.
3. To understand the operation of voltage regulators and active filters used in electronic systems.
4. To analyze the working of timers and phase-locked loops (PLLs) and their applications.
5. To understand the principles and performance of digital-to-analog and analog-to-digital converters

UNIT-I

Op-Amp Applications: Scale changer/inverter, Summing amplifier, Instrumentation amplifier, Instrumentation amplifier IC-AD620, DC and AC amplifiers, V to I and I to V converters, Precision rectifiers, Log and Antilog amplifiers, multiplier and divider, Analog multiplier IC-AD633, Differentiator, Integrator, Analog computation

UNIT-II

Comparators and waveform generators: Comparator, Regenerative comparator (Schmitt Trigger), Astable and Mono-stable multi-vibrators using op-amp, Triangular wave generator, Sine wave generators using op-amp. IC waveform generator (8038).

UNIT-III

Voltage regulators: Series op-amp regulator, IC voltage regulators, 723 General purpose regulator, Switching regulators. Active filters: Low pass, high pass, band pass, band reject and all pass filters, transformation, State variable filter, Switched capacitor filters, Switched capacitor filter ICs

UNIT-IV

555 Timer: Description of functional diagram, Monostable operation. Applications in monostable mode, Astable operation, Applications in astable mode, Schmitt trigger. Phase Locked Loops: PLL- introduction, block schematic, principles and description individual blocks, IC PLL (565), Voltage controlled oscillator (566), PLL applications- Frequency multiplication, Frequency translation, FM & FSK demodulation



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UNIT-V

D-A and A-D Converters: Basic DAC Techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R ladder, Monolithic DAC IC-1409, A-D converters, direct type ADCs, the parallel comparator(flash) A/D converter, The counter type A/D converter, Servo tracking A/D converter, Successive approximation converter, Integrating type of ADCs, Charge balancing ADC, Dual-slope ADC, DAC/ADC specifications

Text Books :

- 1.D.RoyChoudary, ShailBala Jain, “Linear Integrated circuits”, New Age International publishers, 2018.
- 2.Ramakant A.Gayakward, “Op-amps and linear Integrated circuits”, LPE, 4th edition, Pearson Education.
- 3.S.Salivahanan, V.S.KanchanaBhaaskaran “Linear Integrated circuits”, TMH, 2008.
- 4.David A. Bell, “Operational amplifiers and Linear ICs”, PHI, EEE, 1997.
- 5.J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992. Sons, 1975

Course outcomes: Upon successful completion of the course, the student will be able to:

1. Understand and analyze operational amplifier applications.
2. Study comparators and waveform generation circuits using op-amps and ICs.
3. Understand the operation of voltage regulators and active filters used in electronic systems.
4. Analyze the working of timers and phase-locked loops (PLLs) and their applications.
5. Understand the principles and performance of digital-to-analog and analog-to-digital converters

Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	-	-	-	-	-	-	-	1	3	2
CO2	3	2	3	-	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	2	2	3
CO5	3	3	2	-	-	-	-	-	-	-	-	2	3	3

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MICROPROCESSORS AND MICROCONTROLLERS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	3-0-0	7-4-4-05R25	EC

Course Overview: The purpose of this course is to teach students the fundamentals of Microprocessor and Microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a Microprocessor / Microcontroller implementation. This course will start with a discussion on a simple microprocessor, 8085. Understanding this architecture is the basis to follow any other complex CPU architecture. It will be followed by a complete overview of a range of microcontrollers covering 8051 and ARM. The hardware intricacies of these processors and their programming will be covered.

Pre-requisite Courses: Digital Logic Design, Analog Circuits.

Course Objectives: The purpose of the course is

1. To familiarize the Architecture, Instructions and Timings of microprocessors and micro controllers.
2. To introduce 8051 architecture and programming of microcontrollers.
3. To provide the knowledge about interfacing techniques of I/O and memory.
4. To understand the concepts of ARM architecture and Advanced ARM processors

Unit-I

Overview of microcomputer systems and their building blocks, Introduction to 8-bit microprocessor (8085) Architecture, addressing modes, Instruction set, Machine cycles, instruction cycle and timing states, instruction timing diagrams, simple programs in 8085.

Unit-II

Semiconductor memories: RAM, ROM, SRAM, and DRAM. Memory interfacing, concepts of interrupts and Direct Memory Access.

8086 microprocessor – Architecture, Instruction set, Addressing modes, Interrupt system. Minimum mode 8086 system, Maximum mode 8086 system and timing diagrams, simple programs.

Unit-III

8051Microcontroller:Architecture, registers, addressing modes, Instruction set, Interrupt structure, I/O ports functions, timer and serial port operations, External memory interfacing with 8051. Assembly language programming of 8051, Parallel I/O Ports, Interrupts, Timer and Counter, Serial Communication Programming.



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Unit-IV

I/O interfacing: LED, LCD, Keyboard, Stepper motor, DC Motor, ADC, DAC Interface to 8051. Assemblers and compilers, C language programs, Programming and debugging tools.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, Onboard communication interfaces - I2C, SPI, and CAN.

External communication interfaces: 9-pin RS-232, USB, Bluetooth, Wi-Fi, and Zig Bee. Concepts of virtual memory, Cache memory.

Unit-V

ARM 32-bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence. Architectures of PIC, Architecture of AVR. (Text 5: Ch 1, 2, 3)

Text/Reference Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996. (UNIT I).
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface", Morgan Kaufman Publishers. (UNIT II).
3. Barry B. Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing, Prentice Hall of India Private Limited, New Delhi, 2003, Pearson Education, 2004. (UNIT II).
4. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Penram International Publishing/ Thomson Publishers, 2nd Edition, 2005.
5. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3, 2nd Edition, Newnes, (Elsevier), 2010. (UNIT V).

Course Outcomes: Upon completing this course, the student will have the ability to:

1. Understand the architecture and instruction set of 8085 micro-processor and do assembly language programming.
2. Understand the concepts of Semiconductor memories and architecture and instruction set of 8086 microprocessor.
3. Understand the architecture and instruction set of 8051 micro-controller.
4. Do interface with peripherals like, I/O, A/D, D/A, timer etc and develop systems using micro-controllers or microprocessors.
5. Understand the Architecture of ARM processors, PIC and AVR.



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Mapping of course outcomes with program outcomes:

~~PO~~ ~~CO~~	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	3	-	-	2	-	-
CO2	3	3	2	2	1	-	-	-	3	-	-	2	1	-
CO3	2	2	2	2	2	-	-	-	3	-	-	2	-	-
CO4	3	2	3	3	2	-	-	-	3	-	-	1	-	1
CO5	3	2	3	3	2	-	-	-	3	-	-	1	-	1



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DIGITAL LOGIC DESIGN LABORATORY**Credits: 1.5****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	0-0-3	7-4-4-R25P1	EC

Course Objectives

1. To understand and verify the operation of basic logic gates and combinational logic circuits through hands-on experiments.
2. To design, implement, and analyze combinational logic circuits such as adders, subtractors, multiplexers, decoders, and comparators.
3. To design and test sequential logic circuits including flip-flops, registers, and counters.
4. To implement digital circuits using standard ICs and programmable logic devices and verify their functionality using simulation tools.
5. To develop practical skills in troubleshooting, testing, and validating digital logic circuits using appropriate laboratory instruments and simulation software.

LIST OF EXPERIMENTS:

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Design and realization of a 4 – bit Gray to Binary and Binary to Gray Converter
4. Verify the functionality of Mux and Decoder ICs
5. Design and realization of 4-bit comparator
6. Verify the functionality of Flip-Flop ICs
7. Mod-N counter using 7490 and 74190.
8. Shift register IC 7495

Note: Implement using digital ICs.VHDL Programming:

1. Write structural and dataflow VHDL models for
 - a) 4-bit ripple carry adder.
 - b) 4-bit carry Adder – cum Subtractor.
 - c) 2-digit BCD adder /subtractor
 - d) 4-bit carry look ahead adder
 - e) 8-bit comparator
2. Write a VHDL program in structural model for
 - a) 16:1 mux realization
 - b) 3:8 decoder realization through 2:4 decoder
3. Write a VHDL program in behavioral model for
 - a) 16:1 mux
 - b) 3:8 decoder
 - c) 8:3 encoder
 - d) 8 bit parity generator and checker
4. Write a VHDL program in structural and behavioral models for
 - a) 8 bit asynchronous up-down counter
 - b) 8 bit synchronous up-down counter



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5. Write a VHDL program for 4-bit sequence detector through Mealy and Moore state machines.
 6. Write a VHDL program in behavioral model for 8-bit shift and add multiplier.
 7. Write a VHDL program in structural model for 8-bit Universal Shift Register
- Some of the experiments can be done using any Simulation Software

Course Outcomes: At the end of this course students will have the ability to

1. Construct and verify the functionality of basic combinational circuits using logic gates and universal gates.
2. Design, implement, and test sequential circuits such as flip-flops, counters, and shift registers using digital ICs.
3. Develop structural, behavioural, and dataflow VHDL models for combinational and sequential digital circuits.
4. Simulate and verify digital circuits using VHDL programming and simulation software.
5. Analyze, design, and implement digital systems including converters, multiplexers,

Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	2	1	1	3	2	2	1	2	3	2
CO2	3	2	3	2	2	1	1	3	3	2	1	2	3	2
CO3	3	3	3	2	3	1	1	3	2	2	1	3	3	2
CO4	2	2	2	2	3	1	1	3	2	2	1	2	3	3
CO5	3	3	3	3	3	1	1	3	3	3	2	3	3	3

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ELECTRONIC CIRCUIT ANALYSIS LAB**Credits: 1.5****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	0-0-3	7-4-4-R25P2	EC

Prerequisites: Electronic Devices Laboratory.**Course Objectives**

1. To Analyze experimentally and verify the performance of single-stage and multi-stage transistor amplifiers
2. To Design and evaluate feedback amplifiers.
3. To Design and test different types of oscillators.
4. To Analyze the operation and performance of power amplifiers.
5. To Apply concepts to real life problems in some cases use simulation software to analyse circuits.

Hands-on experiments related to the course contents Electronic circuit analysis.**List of Experiments:**

1. Common Emitter Amplifier.
2. Common Collector amplifier
3. Two Stage RC coupled amplifier
4. Voltage series feedback amplifier
5. Voltage shunt feedback amplifier
6. Current series feedback amplifier
7. Current shunt feedback amplifier
8. RC phase shift oscillator
9. Wien bridge oscillator
10. LC/crystal oscillator.
11. Class A Power Amplifier (Transformer less)
12. Class B Complementary Symmetry



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Some of the experiments can be done using any Simulation Software.

Course Outcomes:

At the end of this course students will have the ability to

1. Analyze and experimentally verify the performance of single-stage and multi-stage transistor amplifiers
2. Design and evaluate feedback amplifiers.
3. Design and test different types of oscillators.
4. Analyze the operation and performance of power amplifiers.
5. Apply concepts to real life problems in some cases use simulation software to analyse circuits.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	3	1	1	-	1	3	2
CO2	3	3	3	1	1	-	-	3	1	1	-	1	3	2
CO3	3	2	3	1	1	-	-	3	1	1	-	1	3	2
CO4	3	2	2	1	1	-	-	3	1	1	-	1	2	3
CO5	3	3	3	2	2	-	-	3	1	1	-	2	3	3



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PYTHON PROGRAMMING

Credits: 2**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
IV	1-0-2	7-4-4-R25S1	EC

Course Objectives

1. To understand the fundamentals of Python programming including data types, control structures, functions, and modules.
2. To apply object-oriented programming concepts in Python for developing modular and reusable programs.
3. To develop Python programs for engineering problem solving and data processing relevant to electronics and communication applications.
4. To implement file handling and database connectivity using Python for data storage and retrieval.
5. To introduce Python libraries and frameworks for simulation, visualization, and application development.

Unit – I

Introduction to Python Programming Language

Introduction to Python Language: What is Python? Why Python? Installing Python on Windows, Python IDLE, Python Literals, Python Data Types Basic Input-Output operations, Operators in Python, Decision making in Python, Conditional execution in Python, Logical and bit operations in Python, Naming Conventions, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Data type conversion, Built in Functions.

UNIT-II

Python Built-in Data Structures

Introduction, List, Tuples, Dictionary, Sets, List Operations append, extend, insert, remove, pop, slice, and reverse, List Comprehension, Dictionary operations, Sorting Dictionaries, Copying Collections, Set operations. Standard python modules math, time, IO and time, Regular expressions, multi-threading.

UNIT-III

Classes & Objects

Classes in Python, Principles of Object-Oriented programming, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes.



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UNIT-IV

Functions, I/O, Exception Handling in Python

Introduction: Defining your own functions, keyword and optional parameters, mapping functions, lambda functions, ·Data Streams · Creating Your Own Data Streams · Access Modes · Writing Data to a File · Reading Data from a File · Additional File Methods · Using Pipes as Data Streams · Handling IO Exceptions ·Working with Directories · Metadata · Errors · Run Time Errors · The Exception Model · Exception Hierarchy Handling Multiple Exceptions.

UNIT-V

Python API development.

Introduction to API, Python API programming, Python web application frameworks, REST API, Python Flask, Flask Environment, Routing, Cookies, Sessions, Running Flask Application, Testing API with POSTMAN client

Text Books:

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher ,Revised and Expanded version (Referred by MIT)
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN- 10: 0199480173
3. Data Structures and Algorithms in Python by Michael T Goodrich and Roberto Tamassia, MichealS Goldwasser, Wiley Publisher (2016)
4. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1 st edition (6th February 2009)

REFERENCES:

1. Dive into Python, Mike 2. Learning Python, 4th Edition by Mark Lutz 3. Programming Python, 4th Edition by Mark L
2. Fundamentals of Python Programming, Richard L. Halterman Updated content of the book is maintained under the URL:<http://python.cs.southern.edu/pythonbook/pythonbook.pdf>
3. The official Python Tutorial. <http://docs.python.org/tut/> How to think like a computer scientist(interactive) <http://interactivepython.org/runestone/static/thinkcspy/index.html>



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4. How to think like a computer scientist
<http://openbookproject.net/thinkcs/python/english3e/>
5. Code Academy Python <http://www.codecademy.com/tracks/python>
6. A useful hands-on book: <http://anh.cs.luc.edu/python/hands-on/3.1/Hands-onPythonTutorial.p>

Course Outcomes: At the end of this course students will have the ability to

1. Apply object-oriented programming principles and best coding practices to develop efficient Python programs.
2. Write clear and effective python code.
3. Design and develop standalone and real-time applications using Python programming.
4. Implement and manage databases using SQLite and MS-Access integrated with Python applications.
5. Design and develop web applications and RESTful APIs using Python web frameworks such as Flask and FastAPI.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	1	1	1	2	2	1	3
CO2	3	3	2	1	2	1	1	1	2	3	1	3
CO3	3	3	3	2	3	1	1	1	3	2	2	3
CO4	3	2	3	2	3	1	1	1	2	2	2	2
CO5	3	3	3	3	3	1	1	1	3	3	2	3



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CONSTITUTION OF INDIA

Credits: 0**Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
IV	2-0-0	7-0- 4-R25M1	CH,CE,EE,EC,ME,CS

Course Educational Objectives(CEOs):

Students will learn:

1. To Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit-I

History of Making of the Indian Constitution: History ,Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble Salient Features

Unit-II

Contours of Constitutional Rights & Duties:

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit-III

Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President



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- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit-IV

Local Administration:

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit-V

Election Commission:

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes(COs):

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.



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CO-PO Mapping

PO&PSO/ CO	PO (1)	PO (2)	PO (3)	PO (4)	PO (5)	PO (6)	PO (7)	PO (8)	PO (9)	PO (10)	PO (11)	PO (12)
CO1	2	2	-	-	2	1	2	-	-	2	1	1
CO2	2	1	1	-	1	1	-	-	-	1	1	1
CO3	2	2	-	-	2	1	2	-	-	2	1	1
CO4	-	-	-	-	2	1	2		-	2	1	1

1 - Slightly; 2 - Moderately; 3 – Substantially



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B. Tech. (Electronics and Communication Engineering)
Semester V (Third Year)

Code		Category	Course Title	Hours/Week			Total	Credits	Marks		
Department	University			L	T	P			CIE	SEE	Total
EC 4501C	7-4-5-01R25	EC-PC	Digital Communications	3	0	0	3	3	40	60	100
EC 4502C	7-4-5-02R25	EC-PC	Digital Signal Processing	3	0	0	3	3	40	60	100
EC 4503C	7-4-5-03R25	EC-PC	Antennas and wave propagation	3	0	0	3	3	40	60	100
EC 4504E	7-4-5-R25E1	EC-PE	Professional Elective - 1	3	0	0	3	3	40	60	100
EC 4505L	7-4-5-R25P1	EC-PC	IC Applications Lab	0	0	3	3	1.5	40	60	100
EC 4506L	7-4-5-R25P2	EC-PC	Analog and Digital Communication Lab	0	0	3	3	1.5	40	60	100
EC 4507L	7-4-5-R25P3	EC-PC	Microprocessors and Microcontrollers Lab	0	0	3	3	1.5	40	60	100
EC 4508S	7-4-5-R25S1	EC-SC	Internet of Things and Applications	1	0	2	3	2	100	0	100
EC 4509K	7-4-5-R25KS	EC-IK	IKS – MOOCS	0	0	0	0	2	0	100	100
EC 4510I	7-0-5-R25CS	EC-CS	Community Service Project (CSP)	0	0	0	0	2	100	0	100
				13	0	11	24	22.5	480	520	1000

Students shall ensure that IKS MOOKS and IKS Mandatory courses are not same either in title and/or in syllabi.



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ELECTRONICS & COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES

Professional Elective - I: (V Sem)	7-4-5-R25E11	Computer Organization and Architecture
	7-4-5-R25E12	Electronic Instrumentation (LIM)
	7-4-5-R25E13	Sensors and Actuators
	7-4-5-R25E14	RF Circuit Design
Professional Elective – II (VI Sem)	7-4-6-R25E11	Cyber Security
	7-4-6-R25E12	Neural Networks and Fuzzy Logic
	7-4-6-R25E13	Real Time Operating Systems (RTOS)
	7-4-6-R25E14	Radar Engineering
Professional Elective – III (VI Sem)	7-4-6-R25E21	ITC (Information Theory & Coding)
	7-4-6-R25E22	DSP Architecture and Processors
	7-4-6-R25E23	Digital Design through Verilog
	7-4-6-R25E24	Electronic System Package
	7-0-6-R25CE1	Introduction to Semiconductor Manufacturing
Professional Elective – IV (VII Sem)	7-4-7-R25E11	Satellite Communication
	7-4-7-R25E12	Advanced Programmable Logic Design
	7-4-7-R25E13	Embedded Systems
	7-4-7-R25E14	EV (Alternate Energy sources)
Professional Elective – V (VII Sem)	7-4-7-R25E21	Advanced Communication Networks
	7-4-7-R25E22	Nano Electronics
	7-4-7-R25E23	Wireless Sensor Networks
	7-4-7-R25E24	Quantum Communications
Professional Elective – VI (VII Sem)	7-4-7-R25E31	Hardware and Software Code Design
	7-4-7-R25E32	FPGA
	7-4-7-R25E33	Embedding Sensors and Motors
	7-4-7-R25E34	Cellular and Mobile Communication



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DIGITAL COMMUNICATIONS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4- 5-01R25	EC

Course Description:

This course provides a comprehensive introduction to the principles and techniques of digital communication systems. It covers the fundamental concepts of source coding, baseband and pass band digital transmission, signal space analysis, and error control coding. Students will learn how information is represented, transmitted, and reliably detected over noisy communication channels. The course emphasizes the analysis of modulation schemes, matched filtering, inter-symbol interference, probability of error, and coding techniques for improving system performance. By integrating theoretical foundations with practical system considerations, the course prepares students to understand and analyze modern digital communication systems used in wireless, satellite, optical, and data networking applications.

Course Objectives:

1. To understand and analyze source coding techniques
2. To study baseband pulse transmission concepts
3. To apply signal space analysis techniques
4. To analyze pass band digital modulation schemes
5. To understand and design error control coding techniques

UNIT I

Source Coding Systems: Sampling, Quantization, Quantization noise, Encoding, Pulse Code Modulation (PCM), Line codes, Regeneration, Decoding and Filtering, Noise considerations in PCM systems, Time- Division Multiplexing (TDM), Synchronization, Differential encoding, Delta modulation (DM), Differential Pulse Code Modulation (DPCM), Processing gain, Adaptive Delta Modulation (ADM).

UNIT II

Introduction to Baseband Pulse Transmission, Matched filter and it's Properties, Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference (ISI), Nyquist's criterion for distortion less baseband binary transmission, Duo binary, Modified duo binary in Correlative-level coding, Baseband M-array PAM transmission, Eye diagrams



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UNIT III

Signal Space Analysis: Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the Continuous AWGN channel into a vector channel, Coherent detection of signals in noise, Correlation receiver, Probability of error

UNIT IV

Pass band Data Transmission: Introduction, Pass band transmission model, ASK, Coherent Phase Shift Keying – Binary phase shift keying (BPSK), Quadrature shift keying (QPSK), Binary Frequency shift keying (BFSK), M-array Quadrature Amplitude Modulation (M-array QAM), Non-coherent orthogonal modulation -Differential PSK, Non-Coherent Binary FSK, Error probability, Generation and Detection, Power spectra, signal constellation diagram .

UNIT V

Error Control Coding: Repetition & Parity Check Codes, Interleaving, Code Vectors and Hamming Distance, Forward Error Correction (FEC) Systems, Linear Block Codes, Cyclic Codes, Convolutional Encoding methods- Code Tree, Trellis and State Diagram, Decoding Methods- Sequential, Viterbi

Text Books :

1. Simon Haykin, “Communication Systems,” by John Wiley & Sons, 3rd Edition, 2010.
2. Sam Shanmugam, “Digital and Analog Communication Systems”, Wiley-India edition, 2006

REFERENCES:

1. B. P. Lathi, “Modern Digital and Analog Communication Systems,” Oxford Univ. press, 3rd Edition, 2006.
2. J.S. Chithode, “Digital Communications”, Technical Publications, 1st Edition, 2020
3. Bruce Carlson, & Paul B. Crilly, “Communication Systems – An Introduction to Signals & Noise in Electrical Communication”, McGraw-Hill International Edition, 5th Edition, 2010



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Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the Digital communication System and able to analyse the different Digital modulation techniques.
2. Understand the concepts of baseband digital modulation schemes and Inter Symbol Interference.
3. Analyze Signal space concepts, probability of error performance of various digital binary modulation systems and are able to design digital communication systems.
4. Design a system with Error correcting codes by learning Block Codes, Cyclic Codes and Convolution Codes.
5. Analyses of error control coding

Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	-	3	2
CO2	2	1	1	2	-	-	-	-	-	-	-	-	2	3
CO3	1	1	1	1	-	-	-	-	-	-	-	-	3	2
CO4	1	1	1	2	1	-	-	-	-	-	-	1	2	2
CO5	2	2	1	2	1	-	-	-	-	-	-	1	3	3



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DIGITAL SIGNAL PROCESSING

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4-5-02R25	EC

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Analyze the digital signals using various digital transforms DFT, FFT etc. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Introduction to Multirate signal processing, TMS DSP processors.

Course Learning Objectives:

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. It will provide knowledge of Digital filter.
3. Design and develop the basic digital system.
4. To discuss multi rate signal processing and applications.
5. Knowledge on TMS DSP processors and their applications

Unit -1**Discrete Fourier Transform:**

Review of Discrete-time Fourier Transform, Z-Transform, Discrete Fourier transform – Properties, linear convolution, circular convolution of sequences using DFT. Computation of DFT.

Fast Fourier Transforms: Fast Fourier transforms (FFT)-Radix2 decimation in time and decimation in frequency FFT algorithms, inverse FFT and FFT for composite N.

Unit-2

IIR Digital Filters: Analog filter approximations-Butterworth and Chebyshev, design of IIR digital filters from analog filters, design examples: analog-digital transformations. Realization structures for IIR filters – direct, canonic, cascade, parallel forms

Unit-3

FIR Digital Filters: Characteristics of FIR digital filters, frequency response. Design of FIR digital filters using window techniques, frequency sampling technique. Realization structures of FIR Filter - Transversal, Poly-phase and Linear phase structures. comparison of IIR and FIR filters.



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Unit -4

Multirate Digital Signal Processing Fundamentals: Basic sample rate alteration devices, Multirate Structures for sampling rate Converters, Multistage design of decimator and Interpolator, Polyphase Decomposition.

Unit -5**DSP PROCESSORS:**

Architecture of TMS320C5X: Introduction, Bus structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped Registers, Program controller, some flags in the status registers, On-chip memory, On-chip peripherals.

Text Books

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education/PHI, 4th ed., 2007.
2. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach", Tata McGraw Hill, 3rd edition, 2009.
3. A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", Prentice Hall of India.
4. B. Venkataramani, M. Bhaskar, Digital Signal Processors: Architecture, Programming and Applications, Tata McGraw Hill, 2002.
5. Handouts on DSP Processors.
6. Texas Instruments DSP Processor user manuals and application notes

Course Outcomes: Students must be able to:

1. Apply DFT & FFT for the analysis of digital signals and systems.
2. Design and implementation of IIR filters.
3. Design and implementation of FIR filters.
4. Understand and analyse the Multirate Filters and their implementation.
5. Understand the Architecture of a DSP processor.

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	3	3
CO4	3	2	2	2	2	-	-	-	-	-	-	2	3	2
CO5	3	2	1	1	3	-	-	-	-	2	-	3	2	3

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ANTENNAS AND WAVE PROPAGATION

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4-5-03R25	EC

Course Description: Antennas and propagation effects play a crucial role in RF systems. In practice, the design of a working system such as mobile phone networks, WiFi, RFID, Satellite communication and GPS requires a good understanding of these components. This course teaches the fundamentals of antenna and propagation and shows the application in practical examples. The course covers the theory of radiation, fundamental antenna parameters and concepts, wire antennas such as dipoles and loop antennas, antenna arrays, aperture antennas, microstrip antennas, numerical analysis, communication & radar systems and propagation effects

Course Objectives:

1. To understand the concept of radiation, antenna definitions and significance of antenna Parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To analyze the characteristics and design relations of UHF, VHF and Microwave Antennas.
3. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

UNIT-I

Antenna Basics: Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials–Helmholtz Theorem, Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths. Loop Antennas


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UNIT-II

Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays

UNIT-III

VHF, UHF and Microwave Antennas - I: V- Antenna, inverted V- antenna, Rhombic antenna, log periodic antenna Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Helical Antenna in Axial and Normal Modes, Horn Antennas – Optimum Horns, Design Considerations of Pyramidal Horns

UNIT-IV

VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features, lens antenna

UNIT-V

Ground Wave Propagation –Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering phenomena, Troposphere Propagation. Sky Wave Propagation –Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation

Text Books :

1. Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition, 2000.
3. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
4. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001..


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Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the basic parameters of antenna (L1)
2. Apply the concepts to various antennas based on frequency, configuration and establish the radiation patterns of antenna arrays (L2)
3. Analysis of VHF, UHF and Microwave Antennas (L3)
4. Design and analysis of microstrip antennas (L4)
5. To understand the wave propagation in different frequency ranges (L5)

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	2	1	2	1	3	3	-	2
CO2	3	3	2	2	1	2	3	2	2	1	3	3	-	2
CO3	3	2	2	2	1	2	3	1	1	1	2	3	-	3
CO4	3	3	2	3	2	2	3	-	1	1	2	3	-	3
CO5	3	2	1	-	1	-	2	1	2	1	3	3	-	3



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IC APPLICATIONS LABORATORY**Credits: 1.5****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	0-0-3	7-4- 5-R25P1	EC

Course Objectives

1. To understand the operation and applications of linear and non-linear integrated circuits
2. To design and analyze op-amp based circuits including amplifiers, filters, and waveform generators.
3. To study the functioning of timing and control ICs such as 555 timer and their applications in electronic systems.
4. To analyze and implement data conversion circuits using DAC and ADC integrated circuits.
5. To develop practical skills in testing, troubleshooting, and validating IC-based circuits using laboratory instruments and simulation tools.

Hands-on experiments related to the course contents

List of Experiments:

1. Op-Amp Applications – I
2. Op-Amp Applications – II
3. Astable multi vibrator using Op-Amp
4. 3-Bit Weighted Register DAC
5. Precision Rectifier
6. Low Pass Filter
7. Schmitt Trigger
8. Waveform Generator using IC 8038
9. Monostable Multivibrator using 555 Timer
10. IC 723 Voltage Regulator using Multisim software
11. Astable Multivibrator using 555 Timer
12. 2's Complement Adder and Subtractor
13. Monostable using Op-Amp

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Course Outcomes: After the completion of the course the student will be able to

1. Design applications of IC 741 Op-amp.
2. Design multi vibrator using Op-Amp
3. Realize analog filters using Op-amp.
4. Design multi vibrators using 555 IC.
5. Design voltage 723 voltage regulator using IC's

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	2	1	1	3	2	2	1	2	3	2
CO2	3	2	3	2	3	1	1	3	2	2	1	3	3	3
CO3	3	3	3	2	3	1	1	3	2	2	2	3	3	3
CO4	2	2	3	2	3	1	1	3	2	2	2	3	3	2
CO5	3	3	3	3	3	1	1	3	2	2	2	3	3	2



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ANALOG AND DIGITAL COMMUNICATION LABORATORY**Credits: 1.5****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	0-0-3	7-4- 5-R25P2	EC

Course Description:

This course gives students deep knowledge in analog and Digital communication systems at the practical level so that students can understand the logical, analytical, and mathematical background of the communication system. This lab focuses on understanding the fundamental concepts of signal flow in analog and Digital communication system. The Detailed analysis of AM, FM, Pulse modulations, digital modulation techniques, sampling and reconstruction, Data Conditioning and Reconditioning are done. The course covers the basic types of analog and Digital modulation in both Simulink and equipment based

Course Objectives:

1. The course gives students deep knowledge in analog and digital communication systems at the practical level.
2. The course aims to make the student familiar with Analog and Digital Modulation and Demodulation techniques, transmission, reception etc.
3. The Course aims to write the MATLAB code to study the modulation techniques.
4. The Course aims to simulate the MATLAB code to study the modulation techniques
5. The Course enhance the understanding theory of Analog and Digital Communication concepts.

Hands-on experiments related to the course .List of Experiments:

1. Fourier Synthesis
2. AM Transmitter & Receiver
3. FM Transmitter & Receiver
4. AM/FM Radio Receiver
5. Analog signal sampling & Reconstruction
6. Generation & Detection of PAM/PWM/PPM
7. Generation & Detection of PCM
8. Generation & Detection of DM/SIGMA DELTA/ ADM
9. Baseband digital data transmission
10. Data conditioning & Reconditioning
11. Generation & Detection of BPSK/DPSK/DEPSK
12. Simulation of digital modulation schemes
 - (i) Phase Shift Keying (PSK), differential phase shift keying (DPSK), DEPSK
 - (ii) QPSK, M-ary PSK, Quadrature Amplitude Modulation (QAM)



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Course Outcomes:

After the completion of the course the student will be able to:

1. Generate AM and FM signals and evaluate their performance.
2. Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals.
3. Generate digital modulation signals for ASK, PSK and FSK and perform their detection.
4. Simulate MSK, DPSK, QPSK and DEPSK schemes and estimate their BER.
5. Simulate QPSK, M-ary PSK, Quadrature Amplitude Modulation (QAM)

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	1	2	-	1	3	2
CO2	3	2	2	2	1	-	-	-	1	2	-	1	3	3
CO3	3	2	2	2	2	-	-	-	1	2	-	1	3	3
CO4	2	2	2	3	2	-	-	-	1	3	-	1	2	3
CO5	2	3	2	3	3	-	-	-	1	3	-	2	2	3


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MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credits: 1.5**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	0-0-3	7-4- 5-R25P3	EC

Course Overview: This course introduces the assembly language programming of 8085/ 8986 and 8051 Microcontroller. It gives a practical training of interfacing the peripheral devices with the 8085/8086 microprocessor/ 8051microcontroller. It is useful for developing students to be proficient in the assembly language programming skills and real time applications of Microprocessor as well as microcontroller.

Course Objectives

The purpose of the course is

1. To expose students to the operation of typical microprocessor (8085) and microcontroller (8051) trainer kits.
2. To prepare the students to be able to solve different problems by developing assembly language programs.
3. To develop the building of Microcontroller based systems.

Hands-on experiments related to the course contents. Every student is free to do his / her choice of experiments in the Laboratory. Student can do at least 10 to 12 experiments only.

List of Experiments:

(8085/8086 Microprocessor Assembly Language Programming)

1. Write a simple program for arithmetic operations – addition, subtraction, multiplication and division of 16 – bit number.
2. Write a simple program for string operations like string concatenation, swapping.
3. Write a program for interfacing LCD with 8085 and display a message.
4. Write a program for interfacing Stepper Motor with 8085.
5. Write a program for flashing LEDs using 8253 /8254 (PIT) and interrupts

(8051 Microcontroller Assembly Language Programming)

6. Write a program for performing simple arithmetic operations.
7. Write a program for performing simple Logical operations.
8. Write a simple program for flashing LEDs using software delays, timers and interrupts.
9. Write a program for interfacing Seven Segment Display / LCD with 8051 and display messages.



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10. Write a program for interfacing Keypad with 8051 and display keypad input on LCD.
11. Write a program for square waveform generation, with different frequencies and duty cycles.
12. Write a program for serial communication through UART using polling and interrupt methods.
13. Write a program for interfacing ADC with 8051.
14. Write a program for Pulse Width Modulation using on-chip PWM and analog I/O modules

Course Outcomes: After the completion of the course the student will be able to:

1. Write assembly language programmes for arithmetic and Logical operations using 8085 μ p.
2. Develop assembly language programs / C and C++ programs using microcontrollers.
3. Write 8051 assembly language programs to control inbuilt timer and communication modules.
4. Interface ADC and DAC modules with microprocessor-based systems and Write assembly language programmes using ARM / 8086 processor.
5. Generate and control signals such as PWM and square waves for embedded system applications.

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	1	2	-	1	3	2
CO2	3	3	3	2	2	-	-	-	1	2	-	1	3	3
CO3	3	2	3	2	2	-	-	-	1	2	-	1	3	3
CO4	3	3	3	3	3	-	-	-	1	3	-	2	3	3
CO5	3	3	3	3	3	-	-	-	1	3	-	3	3	3

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INTERNET OF THINGS AND ITS APPLICATIONS

Credits: 2**Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
V	1-0-2	7-4- 5-R25S1	EC

Course Overview:

Internet of Things (IoT) cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support a lot. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different lot solutions. IoT-based applications such as innovative shopping systems, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT-based systems. Therefore, it is very important to learn the fundamentals of this emerging technology

Course Learning Objectives:

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student:

1. To understand the fundamentals of Internet of things and protocols.
2. It introduces some of the application areas where Internet of Things can be applied.
3. To build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
4. To apply the concept of Internet of Things in the real-world scenario.

UNIT I:

Fundamentals of IoT: Introduction to IoT – Characteristics, Sensing, Actuation, Physical Design - Protocols – Logical Design – Enabling technologies – IoT Levels – Six Levels of IoT - Domain Specific IoTs.

UNIT II:

IOT and M2M: M2M, IoT vs M2M, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN and NFV for IoT, IOT system Management with NETCONF-YANG.



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UNIT III:

IoT Design Methodology: IoT Systems Management – IoT Design Methodology – Specifications Integration and Application Development. Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

UNIT IV:

Data Analytics for IoT: Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis.

UNIT V:

Tools for IoT: Chef, Puppet, IOT code generator Case studies: Chef. Puppet – Multi-tier Deployment, NETCONF-YANG.

IOT Applications: IoT applications for industry- Future Factory Concepts, Smart Applications, Smart Cities and Smart Homes. Case Study: Agriculture, Healthcare, Activity Monitoring. Study of existing IoT platforms /middleware, IoT- A, Hydra etc

Text Book & References:

- 1.ArshdeepBahga, Vijay Madisetti, “Internet of Things – A Hands-on Approach”, Universities Press, 2015.
- 2.Chef, Puppet, IOT code generator Case studies: Chef. Puppet – Multi-tier Deployment, NETCONF-YANG, Raspberry Pi.
- 3.Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
- 4.Simon Monk, “Programming the Raspberry Pi: Getting Started with Python”, McGrawHill,2013
- 5.Marco Schwartz, “Internet of Things with the Arduino Yun”, Pack Publishing, 2014

Course Outcomes: Upon completion of this course, students will be able to:

1. Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
2. Develop web services to access/control IoT devices.
3. Deploy an IoT application and connect to the cloud.
4. Analyze data Analytics for IoT
5. Analyze applications of IoT in real-time scenario



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Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	-	1	1	-	-	2	1
CO2	2	2	2	1	1	1	-	-	1	1	1	1	3	1
CO3	1	2	3	1	2	1	-	1	1	2	2	1	3	1
CO4	1	1	2	2	3	1	-	1	2	2	2	1	2	3
CO5	1	2	1	3	2	1	1	-	1	1	1	1	1	3



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PE-I-1 COMPUTER ORGANIZATION & ARCHITECTURE**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4-5-R25E11	EC

Course Overview: It is important to understand Computer Architecture in order to structure a program so that it runs efficiently on a real machine. When selecting a system to use, it is important to understand the tradeoff among various components, so you can accurately compare competing systems, and understand technical literature on new computer systems. This course will cover the basic concepts of Computer organization and its Architecture that are important for you to understand, including the CPU control and data-path, memory systems including caching and virtual memory, and input/output subsystems. Prerequisite Courses: Digital Logic Design

Course Objectives: The purpose of the course is

1. To understand the structure of a computer and its operations.
2. To understand the RTL and Micro-level operations and control in a computer.
3. Understanding the concepts of computer arithmetic, instruction set design, micro-programmed control unit, pipelining and vector processing, I/O Systems and memory organization, and operating systems

UNIT - I:

Basic Structure of Computers: Computer Types, Functional Unit, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating – Point Representation
Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions – Instruction Cycle, Memory – **Reference** Instructions, Input – Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer

UNIT - II:

Micro Programmed Control: Control Memory, Address Sequencing, Microprogram Examples, Design of Control Unit, Hard Wired Control, Microprogrammed Control.
The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories Secondary Storage, Introduction to RAID.



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UNIT - III:

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, Input –Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE 1394.

UNIT - IV:

Operating Systems Overview: Overview of Computer Operating Systems Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating Systems Structures-Operating System Services and Systems Calls, System Programs, Operating Systems Generation. Memory Management: Swapping, Contiguous Memory Allocation, Paging, Structure of The Page Table, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms, Allocation of Frames, Thrashing Case Studies - UNIX, Linux, Windows. Principles of Deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT - V:

File System Interface: The Concept of a File, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection. File System Implementation: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management

Text Books:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, 5th Edition, McGraw Hill.
2. Computer Systems Architecture – M. Moris Mano, IIIrd Edition, Pearson
3. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 8th Edition, John Wiley

References:

1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI
3. Fundamentals of Computer Organization and Design - Sivaraama Dandamudi Springer Int. Edition.
4. Operating Systems – Internals and Design Principles, Stallings, sixth Edition–2009, Pearson Education.
5. Modern Operating Systems, Andrew S Tanenbaum 2nd Edition, PHI



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Course Outcomes: After the completion of the course the student will be able to:

1. Visualize the organization of different blocks in a computer.
2. Use micro-level operations to control different units in a computer.
3. Have knowledge about the organization of Arithmetic and Logical unit and I/O unit.
4. Understand the design of Memory unit, and the overview of computer system hardware.
5. Understand operating system concepts such as process management, memory management, deadlocks, and file systems

Mapping of course outcomes with the program objectives:

P O C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	-	2	-	2	3	2
CO2	3	3	3	2	2	-	-	-	-	2	-	2	3	2
CO3	3	2	3	2	3	-	-	-	-	2	-	2	3	3
CO4	3	3	2	2	2	-	-	-	2	3	-	2	2	3
CO5	3	2	2	1	2	-	-	-	2	3	-	2	2	3

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PE-I-2 ELECTRONIC INSTRUMENTATION**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4- 5-R25E12	EC

Course Description: This course deals with the basics of electronic instruments used in laboratory and industry. In the process they learn different type of instruments like voltmeter , ammeter, Q meter, Bridges, transducers and display devices CRO, CRT. After learning this subject student will be master in working principle and application of all types of instruments

Course Objectives:

1. To explain basic concepts and definitions in measurement.
2. To describe the bridge configurations and their applications.
3. To understand, design aspects and performance criterion of measuring instruments.
4. To understand the working principle of various transducers.

UNIT-I

Measurement and Error: Definitions, accuracy and precision, types of errors.

DC Ammeters, DC Voltmeters, Series type ohmmeter, Shunt type ohmmeter. AC Voltmeter using rectifiers, True RMS responding voltmeter. Analog Instruments – Transistor voltmeter, micro voltmeter (chopper type) - DC differential voltmeter - AC voltmeters.

UNIT-II

Cathode Ray Oscilloscopes : Motion of electron in electric field and in magnetic field – Block diagram of CRO, CRT, Electrostatic deflection sensitivity – Vertical and Horizontal deflection systems – Principle of operation of Dual beam, Digital, Dual trace, Sampling and Storage CROs – Measurements with CRO (voltage, current, time, frequency, phase angle, Lissajous figures).

UNIT-III

Q meter and measurement methods. Bridges: Wheatstone, Kelvin's, Maxwell, Hay and Schering bridges. Wave analyzers (AF & RF) - Harmonic distortion analyzers – Spectrum analyzer.

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UNIT-IV

Digital instruments – Digital voltmeters (Ramp, Dual slope, stair case, successive approximation types) Digital Multimeter, universal counter, Digital tachometer, Digital phase meter IEEE 488 Bus.

UNIT-V

Transducers – Classification and selection of transducers – strain gauges – Temperature measurement (resistance thermometer, thermo couples and thermistors) LVDT – Piezo electric transducer

Text Books :

1. H.S.Kalsi, "Electronic Instrumentation" TMH, 1995.
2. Helfric and Cooper, "Modern Electronic Instrumentation and measurement techniques", PHI, 1995.
3. A.K.Sawhney , " Electrical and electronic measurements and instrumentation", Danapat Rai & Co., 18th edition., 2007

E-resources and other digital material

1. <https://nptel.ac.in/courses/108106070>
2. <https://nptel.ac.in/courses/108106070>

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Emphasize the basic electronics measurement concepts
2. Design the different analog and digital electronics voltmeters
3. Identify and use different analyzers and oscilloscopes.
4. Design the Measurement of different bridges & generators to make measurements and analyze measurement.
5. Analyze the concepts of Transducers based on applications

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	-	-	-	-	-	-	-	-	2	1
CO2	3	2	-	3	1	-	-	-	-	-	-	-	3	2
CO3	2	2	-	3	-	-	-	-	-	-	-	-	3	2
CO4	3	2	-	2	3	-	-	-	-	-	-	-	2	3
CO5	3	2	-	-	3	-	-	-	-	-	-	-	3	3


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PE-I-3 SENSORS AND ACTUATORS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4-5-R25E13	EC

Course Objectives:

1. To provide exposure to various kinds of sensors and actuators and their engineering applications.
2. To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
3. To explain the operating principles of various sensors and actuators
4. To educate the fabrication of sensors
5. To explain the required sensor and actuator for interdisciplinary application

UNIT I**Introduction to Sensors and Actuators**

Sensors: Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching. **Actuators:** Functional diagram of actuators, Types of actuators and their basic principle of working: Pneumatic, Electromagnetic, Piezo-electric and Piezo-resistive actuators, Applications of Actuators.

UNIT II**Temperature and Mechanical Sensors**

Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo- resistive sensors: Thermistors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors.

Mechanical Sensors: Types of Mechanical sensors and their basic principle of working: Force sensors: Strain gauges, Tactile sensors, Pressure sensors: Piezo resistive, Variable Reluctance Sensor (VRP).

UNIT III**Optical and Acoustic Sensors**

Optical Sensors: Basic principle and working of: Photodiodes, Phototransistors and Photo resistors based sensors, Photomultipliers, Infrared sensors: thermal, Passive Infra-Red, Fiber based sensors and Thermopiles **Acoustic Sensors:** Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones

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UNIT IV**Magnetic and Electromagnetic Sensors**

Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magnet ostrictive sensors and actuators

UNIT- V**Chemical and Radiation Sensors**

Chemical Sensors: Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

Radiation Sensors: Principle and working of Ionization detectors, Scintillation detectors, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)

Text Books:

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015
2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

Reference Books:

1. Sensors and Transducers- D.Patranabis, Prentice Hall of India (Pvt) Ltd. 2003
2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999
3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.
4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch

Course outcomes :

1. To provide exposure to various kinds of sensors and actuators and their engineering applications.
2. To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
3. To explain the operating principles of various sensors and actuators
4. To educate the fabrication of sensors
5. To explain the required sensor and actuator for interdisciplinary application

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	1	-	-	1	-	-	3	2	1
CO2	3	3	2	-	3	-	-	-	-	-	-	2	3	2
CO3	2	2	3	-	3	-	-	-	2	1	1	2	3	3
CO4	2	3	2	3	3	-	-	-	1	-	-	3	2	3
CO5	1	2	3	-	3	-	-	-	1	3	1	2	3	3

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PE-I-4 RF CIRCUIT DESIGN**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
V	3-0-0	7-4-5-R25E14	EC

Course Overview:

The RF Circuits course introduces the design, analysis, and operation of radio-frequency (RF) circuits used in wireless communication systems such as mobile phones, Wi-Fi, satellite, radar, and IOT devices

Course Objectives: The purpose of the course is to

1. Understand RF signal behaviour at high frequencies and Design basic RF front-end circuit.
2. Analyze RF amplifiers, oscillators, mixers, and matching networks

UNIT- I**Introduction:**

Importance of RF Design-Dimensions and Units-Frequency Spectrum-RF Behaviour of passive components. High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors-chip components and circuit board considerations : Chip Resistors, Chip Capacitors, and surface Mount Inductors.

Review of Transmission Lines:

Types of Transmission Lines-Equivalent Circuit representation-R,L,C,G parameters of Different Line configurations-Terminated Lossless Transmission Lines-Special Terminations: Short circuit, open circuit and Quarter wave transmission lines-sourced and Loaded transmission Lines Power considerations, Input Impedance Matching, Return loss and Insertion loss

UNIT- II:**Single and Multi-Port Networks:**

The smith chart: Reflection Coefficient, Normalized Impedance-Impedance Transformation: Standing wave ratio, special transformation conditions-Admittance Transformation-Parallel and Series RL & RC connections-Basic Definitions of Single and Multi-port Networks-Interconnecting Networks.

RF Filter Design:

Scattering Parameters: Definition, Meaning, chain scattering matrix, conversion between s- and z-parameters, signal flow chart modelling, generalization-basic resonator and filter configurations: low pass, high pass, band pass and band stop type filters-Filter implementation using unit element and Kuroda's Identities transformations-coupled filters

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UNIT- III**Active RF component Modelling:**

RF Diode Models: Nonlinear and Linear Models-Transistor models: Large Signal and small signal BJT models, Large signal and small signal FET models- Scattering Parameter, Device Characterization.

UNIT- IV :**Matching and Biasing Networks:**

Impedance Matching using discrete components two component matching networks, forbidden regions, frequency response and quality factor, T and Pi Matching Networks- Amplifier Classes of Operation and Biasing Networks: Classes of Operation and Efficiency of Amplifiers, Biasing Networks for BJT, Biasing Networks for FET

UNIT- V : RF Transistor and Amplifier Design:

Characteristics of Amplifiers- Amplifier power relations: RF source, transducer power gain, additional power relations-stability considerations: stability circles, unconditional stability, and stabilizations Methods-Unilateral and Bilateral Design for constant gain-Noise figure circles-constant VWSR circles.

RF Oscillators and Mixers:

Basic Oscillator Model: Negative Resistance Oscillator, Feedback oscillator design, Design steps, Quartz Oscillators- Fixed Frequency high frequency oscillator- Basic characteristics of mixers concepts, Frequency Domain considerations, single ended mixer design, single and double balanced mixers.

Text Books:

1. RF Circuit Design- Theory and Applications by Reinhold Ludwig, Pavel Bretchko- Pearson Education India, 2000.
2. Radio Frequency and microwave communication circuits- Analysis and Design by Devendra K.Misra-Wiley Student Edition-John Wiley & Sons, Inc

Reference Books:

1. Radio frequency and Microwave Electronics-Illustrated by Matthew M.Radmanesh- PEI.
2. RF circuit design – Christopher Bowick, Cheryl Aljuni and John Biyler, Elsevier Science, 2008.
3. Secrets of RF circuit Design by Joseph J.Carr, TMH, 2000


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Course outcomes:

1. Understand RF signal behavior, high-frequency components, and transmission line characteristics
2. Analyze single-port and multi-port RF networks using smith chart
3. Explain RF device models including diodes, BJTs, and FETs under large and small-signal conditions.
4. Design impedance matching and biasing networks for RF amplifiers.
5. Understand the design principles of RF amplifiers, oscillators, and mixers for high-frequency applications

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	3	2
CO3	2	3	3	2	1	-	-	-	-	-	-	1	3	2
CO4	2	3	3	2	2	-	-	-	-	-	-	1	3	3
CO5	2	3	3	2	2	-	-	-	-	-	1	2	3	3


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B. Tech. (Electronics and Communication Engineering)
Semester VI (Third Year)

Code		Category	Course Title	Hours/Week			Total	Credits	Marks		
Department	University			L	T	P			CIE	SEE	Total
EC 4601C	7-4-6-01R25	EC-PC	Microwave and Optical Communications	3	0	0	3	3	40	60	100
EC 4602C	7-4-6-02R25	EC-PC	Communication Networks	3	0	0	3	3	40	60	100
EC 4603C	7-0-6-R25M1	EC-PC	Elements of Quantum Computing	2	0	0	2	2	100	0	100
EC 4604E	7-4-6-R25E1	EC-PC	Professional Elective – II	3	0	0	3	3	40	60	100
EC 4605E	7-4-6-R25E2	EC-PC	Professional Elective - III	3	0	0	3	3	40	60	100
EC 4606O	7-4-6-R25O1	EC-OE	Open Elective –I (MOOCS)	0	0	0	0	3	0	100	100
EC 4607L	7-4-6-R25P1	EC-PC	Digital Signal Processing Lab	0	0	2	2	1	40	60	100
EC 4608L	7-4-6-R25P2	EC-PC	Communication Network Lab	0	0	2	2	1	40	60	100
EC 4609S	7-4-6-R25S1	EC-SC	VLSI Design	2	0	2	4	3	100	0	100
EC 4610I	7-4-6-R25M1	EC-IK	IKS - Mandatory	2	0	0	2	0	100	0	100
TOTAL				18	0	6	24	22	540	460	1000
Students shall undergo summer Industrial Internships for a duration of six to eight (6-8) weeks during the summer vacation by completing 45 – 60 hours of work with at least 75% attendance, to be evaluated and reflected in 7 th semester.											
Students shall ensure that IKS MOOKS and IKS Mandatory courses are not same either in title and/or in syllabi.											



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ELECTRONICS & COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES

Professional Elective - I: (V Sem)	7-4-5-R25E11	Computer Organization and Architecture
	7-4-5-R25E12	Electronic Instrumentation (LIM)
	7-4-5-R25E13	Sensors and Actuators
	7-4-5-R25E14	RF Circuit Design
Professional Elective – II (VI Sem)	7-4-6-R25E11	Cyber Security
	7-4-6-R25E12	Neural Networks and Fuzzy Logic
	7-4-6-R25E13	Real Time Operating Systems (RTOS)
	7-4-6-R25E14	Radar Engineering
Professional Elective – III (VI Sem)	7-4-6-R25E21	ITC (Information Theory & Coding)
	7-4-6-R25E22	DSP Architecture and Processors
	7-4-6-R25E23	Digital Design through Verilog
	7-4-6-R25E24	Electronic System Package
	7-0-6-R25CE1	Introduction to Semiconductor Manufacturing
Professional Elective – IV (VII Sem)	7-4-7- R25E11	Satellite Communication
	7-4-7- R25E12	Advanced Programmable Logic Design
	7-4-7- R25E13	Embedded Systems
	7-4-7- R25E14	EV (Alternate Energy sources)
Professional Elective – V (VII Sem)	7-4-7-R25E21	Advanced Communication Networks
	7-4-7-R25E22	Nano Electronics
	7-4-7-R25E23	Wireless Sensor Networks
	7-4-7-R25E24	Quantum Communications
Professional Elective – VI (VII Sem)	7-4-7-R25E31	Hardware and Software Code Design
	7-4-7-R25E32	FPGA
	7-4-7-R25E33	Embedding Sensors and Motors
	7-4-7-R25E34	Cellular and Mobile Communication



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MICROWAVE AND OPTICAL COMMUNICATIONS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4-6-01R25	EC

Course Description: This course provides a comprehensive understanding of two major high frequency communication domains. Microwave communication and optical communication. The microwave communication portion covers electromagnetic wave frequencies, microwave devices (klystrons, TWT, magnetrons, Gunn and IMPATT diodes), wave guide components, importance of S parameters, advantages of monolithic MIC'S and microwave measurement technique.

The Optical communication section focus on light propagation through optical fibers, fiber types, losses and dispersion, optical sources (LEDs, LASER diodes) detectors(PIN,APD),advanced topics include WDM systems.

Course Objectives:

1. To understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix and microwave measurement techniques.
4. Understand the utility of Optical Fibers in Communications.
5. To impart the knowledge of advanced communication technologies such as WDM/DWDM systems.

UNIT – I

Microwave Devices: Limitations and Losses of conventional Tubes at microwave frequencies. Types of Microwave tubes .Two Cavity Klystron, Reflex Klystron, TWT and Magnetrons – Structure, principle of operation and characteristics. Gunn Oscillation Modes, Principle of operation of IMPATT diode.

Wave guide Components: Coupling Mechanisms- Probe, Loop, Aperture types. Waveguide Attenuators - Waveguide Phase Shifters – Waveguide Multiport Junctions - E plane and H plane Tees, Magic Tee.

UNIT – II

Scattering matrix: Importance of S-matrix, Scattering Matrix Properties, Directional Couplers –2 Hole, Bethe Hole Coupler, S Parameters, S matrix of Magic Tee and Circulator, Measurement of S- parameters.

MICs : Advantages of MIC's, Hybrid MIC's, Strip lines and microstrip lines, Monolithic MICs



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UNIT-III

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurement of Low, Medium and High VSWR, Impedance Measurement, Antenna gain measurements and Directivity measurement

UNIT-IV

Components of Optical Communication: Elements of an optical fiber transmission link, advantages of optical fiber communication. Acceptance angle, numerical aperture, single mode and multimode fibers. fiber material, fibre cables ,connectors and splicer. LEDs: Working principle and characteristics, Laser diodes: Working principle and characteristics, working principle and characteristics of Photo- detectors: PIN-diodes, APDs.

UNIT-V

Optical Networks : Optical Transmitter and Receiver, Bit error rate of Optical Receivers and Receiver performance, Optical link design, BER Calculation, Optical switches , directional couplers, Optical amplifiers - EDFA, Raman amplifier. Principle of WDM systems.

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition
3. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 4t
4. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012
5. Microwave and Radar Engineering, Kulkarni, Umesh publications, 1998.
6. Microwave Engineering, Annapurna Das and SisirK.Das, Tata Mc Graw-Hill, 2000.
7. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
8. John M. Senior, Optical Fiber Communications: Principles and Practice, Pearson, 3rd Ed. 2008.G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994

Course Outcomes :At the end of this course students will have the ability to

1. Understand the operating principles, characteristics, limitations and applications of microwave tubes and analyse waveguide components and junctions.
2. Analyse the Microwave networks using scattering parameters(S Parameters), and evaluate microwave integrated circuits, stripline and microstrip technologies.
3. Perform and interpret microwave measurements using a microwave bench while Understand the measurement errors and precautions.
4. Understand the fundamentals of optical fiber communication systems and associated components.
5. Design and evaluate optical communication networks



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Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	1	-	-	-	-	-	2	1	-
CO2	3	2	3	2	2	2	-	-	-	-	-	2	1	-
CO3	3	2	2	3	2	2	1	-	-	-	3	3	2	1
CO4	3	3	2	3	3	2	-	-	-	-	3	3	2	1
CO5	2	2	2	2	2	1	-	-	-	-	2	2	1	1



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COMMUNICATION NETWORKS

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4-6-02R25	EC

Course Objectives:

1. Introduce the fundamentals of data communication and computer networking,.
2. Explain the role of the physical layer.
3. Develop understanding of the data link layer mechanisms
4. Provide knowledge of network and transport layer functions
5. Familiarize students with application layer protocols and emerging communication technologies,

Unit -1 Overview Of Communication and Networking:

Analog and digital signal, Data communications, Networks, Circuit switching, Packet switching, The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP protocol Architecture.

Unit -2 Physical Layer: Guided media, Unguided media, baseband and pass band transmission of signals(briefly), Telephone modems, FDM, WDM, TDM, Telephone networks, DSL technology, Cable modem, Bluetooth, SONET, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Connecting devices, Backbone network, Virtual LAN

Unit-3 Data Link Layer: Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Random access, Controlled access, Channelization

Unit-4 Network And Transport Layer: Network Layer: Internetworks, Addressing, Routing, ARP,IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols. Transport layer: Process to process delivery, User datagram protocol (UDP),Transmission control protocol (TCP),

Unit-5 Application Layer: DNS (ARP and RARP), Mail protocol (SMTP, POP, IMAP), DHCP, Web services (WWW, HTTP, HTTPS, FTP), telnet, DHCP, Client server and P2P application, Relation between Application layer and Transport Other technologies overview: PSTN, ISDN and its type, Frame relay, DSL and ADSL, VoIP, Bluetooth, Wi-Fi, Overview of GSM, Wi-Max, 3G and 4G(LTE), Near field Communication (NFC).



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Textbooks:

1. Ferouzan, Behrouz A., Data Communications and Networking, 5/e, TATA McGraw Hill, 2017
2. Stallings William, Data and Computer Communication, 10/e, Pearson Education, 2017

Reference Books:

1. Black, Ulylers D, Data Communication and Distributed Networks, 3/e, PHI, 1999.
2. Tanenbaum, Andrew S., Computer Networks, 6/e, PHI, 2022

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Explain the basics of analog and digital communication, networking models, and switching techniques.
2. Identify and compare guided and unguided transmission media, multiplexing methods, and physical layer technologies.
3. Analyze error detection/correction techniques and data link layer protocols for reliable data transmission.
4. Apply concepts of network and transport layer protocols for addressing, routing, and end-to-end communication.
5. Describe the working of application layer protocols and modern communication technologies such as Wi-Fi, VoIP, LTE, and NFC.

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	1	-	2	3	2
CO2	3	2	2	2	2	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2	2	3
CO4	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO5	2	2	1	2	2	1	-	-	-	1	-	3	2	3



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ELEMENTS OF QUANTUM COMPUTING

Credits: 2**Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
VI	2-0-0	7-0- 6-R25M1	EC

Course Objectives

1. To introduce the basic principles of quantum mechanics relevant to computing.
2. To differentiate between classical and quantum computation models.
3. To understand qubits, superposition, entanglement, and quantum gates.
4. To study basic quantum algorithms and their real-world applications.

Course Outcomes

1. Understand basic principles of quantum mechanics relevant to computation.
2. Understand basics of quantum states, qbit and gates.
3. Understand physical implementation of Qubit
4. Understand Quantum algorithms and their implementation
5. Understand The Impact of Quantum Computing on Cryptography

UNIT – I:

Evolution of computation: classical to quantum paradigm, Limitations of classical computation, Basic principles of quantum mechanics relevant to computation.

Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations

UNIT - II

Quantum states and qubits, Superposition principle and quantum measurement. Quantum entanglement and its importance.

Quantum gates: Pauli, Hadamard, Phase, CNOT, Toffoli.

Bloch sphere representation of qubit states.

UNIT - III

Qubit: Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

UNIT - IV

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.



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UNIT - V

Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

TEXT BOOKS:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge

REFERENCE BOOKS:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II.
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms.

Mapping of Course Outcomes with Program Outcomes:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1			1	2	1	1		1	1	1	2
CO2	1	2	2	1	1	1	2		1	1	1	2		
CO3	2	1	3	3	1	1	1				1	3	1	3
CO4	1	2	3	3	1	1	1	1		1	1	3	1	3
CO5	2	2	2	2	2	1	1	1	1		1	3	1	3



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DIGITAL SIGNAL PROCESSING LAB**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4-6-R25P1	EC

Course Description:

The course is to make familiar with practical implementation of the digital signal processing. digital signal processing involving filtering, deconvolution, spectral estimation, and a variety of other techniques. Laboratory work involves developing signal processing systems on a personal computer and using them with both real and simulated data. Questions related to hardware realizations are also considered. Students can able to develop DSP algorithms for convolution, correlation, DFT, filtering of signals etc. Introduction to TMS Processors software and Hardware tools.

Course Objectives

1. To understand and implement fundamental digital signal processing concepts such as sampling, convolution, correlation, and transform techniques using software tools.
2. To design and analyze digital filters including FIR and IIR filters using standard design methods.
3. To study discrete-time signal analysis techniques such as FFT and spectral analysis.
4. To implement DSP algorithms for applications like noise reduction, signal enhancement, and system modelling.
5. To develop proficiency in using DSP software tools and platforms such as MATLAB, Python, or DSP processors for simulation and validation of signal processing systems.

Part A–Using MATLAB

1. Generation of standard signals, periodic and Aperiodic signal
2. DFT and IDFT
3. FFT algorithms-Decimation in Time/Decimation in Frequency.
4. Linear and Circular Convolution in time domain and infrequency domain(using DFT)
5. Spectrum Analysis using DFT
6. IIR filter design
7. FIR filter design
8. Decimation and Interpolation



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Part B–Using Code Composer Studio

1. Linear convolution of two sequences.
2. Circular convolution of two sequences.
3. Generation of Elementary signals.
4. MAC operation using various addressing modes
5. FIRI implementation

Text Books:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007
2. A.V. Oppenheim, R. W. Schaffer, Discrete-Time Signal Processing, 3/e, Prentice Hall of India, 2009

Reference Books:

1. Fundamentals of Digital Signal Processing - Lonnie C Ludeman, John Wiley & Sons, 2003
 2. Digital Signal Processing “A – Computer Based Approach” - Sanjit K Mitra, Tata Mc Graw Hill 2nd Edition, 2003
 3. Theory and Application of Digital Signal Processing - Lawrence R Rabiner & Bernard Gold, Prentice Hall
- e- Resources & other digital material**
1. <http://www.nptel.iitm.ac.in/>
 2. <http://www.ee.umanitoba.ca/~moussavi/dsp815/LectureNotes/index.html>
 3. <http://www.ece.cmu.edu/~ee791>
 4. <http://cobweb.ecn.purdue.edu/~ipollak/ee438/FALL04/notes/notes.html>

Course Outcomes:

Upon successful completion of the course, the student will be able to

1. Interpret discrete-time signals using DFT
2. Apply FFT algorithms for various signal processing operations
3. Design the multirate Filters
4. Perform convolution, correlation, decimation, and interpolation operations.
5. Design IIR and FIR digital filters for real time DSP applications

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	3	-	-	-	-	-	1	-	2	2	3	1
CO2	3	2	3	-	2	-	-	-	-	-	2	2	3	1
CO3	3	2	2	2	-	-	-	-	3	-	2	2	3	1
CO4	3	2	2	2	-	1	-	-	3	-	1	2	3	1
CO5	2	1	2	1	1	1	-	-	2	-	1	1	2	1

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COMMUNICATION NETWORK LAB**Credits: 1****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	0-0-2	7-4- 6-R25P2	EC

Course Over view: This course is designed to impart knowledge about detailed knowledge of Computer Networks, various protocols used in Communication, Managing and configuring Cisco Switches and Routers, and various WAN technologies. Learn basic concepts of computer networking and acquire practical notions of protocols with the emphasis on TCP/IP

Course Objectives

1. To understand the fundamentals of data communication and networking **concepts** through practical experiments.
2. To analyze the performance of communication networks using parameters such as throughput, delay, packet loss, and bandwidth.
3. To study and implement network protocols at different layers of the OSI and TCP/IP models.
4. To simulate and evaluate wired and wireless network scenarios using network simulation tools.
5. To develop skills in configuring, testing, and troubleshooting communication networks and related applications.

Major Equipment Required: Required software (Open Source) like NS-2, NSG-2.1 and Wire SHARK

Note:

- (a). Minimum of 12 Experiments have to be conducted
- (b). All the Experiments may be Conducted using Network Simulation software like NS-2, NSG-2.1 and Wire SHARK/equivalent software.

For Experiments 2 to 10 Performance may be evaluated through simulation by using the parameters Throughput, Packet Delivery Ratio, Delay etc.

List of Experiments:

1. LAN Configuration.
2. IP Addressing.
3. Error Correction and Error Detection.
4. Routing Algorithms
5. FCFS and SJF algorithms



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6. Round Robin Algorithm.
7. Peer to peer file sharing and Socket Programming
8. RSA algorithm
9. DNS look up table
10. HTML Design
11. HTTP

Implement basic network connectivity between devices

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

1. Understand network technologies and to access local and remote networks.
2. Implement and evaluate routing and scheduling algorithms.
3. Operate switching in a small to a medium-sized business network.
4. Design an IPv4 and IPv6 addressing scheme to provide network connectivity for a small to a medium-sized business network.
5. Implement basic network connectivity between devices.'

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	1	1	-	-	-	3	-	2	1	2	1
CO2	3	2	2	1	2	-	-	-	3	-	2	1	2	1
CO3	2	2	2	2	-	-	-	-	3	-	2	1	2	1
CO4	3	2	3	2	3	-	-	-	3	-	1	2	2	-
CO5	2	1	2	1	-	-	-	-	2	-	1	1	1	1



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VLSI DESIGN**Credits: 3****Assessment: 100 + 0**

Semester	L-T-P	Course Code	Branches
VI	2-0-2	7-4- 6-R25S1	EC

Course Overview:

This course introduces students to VLSI design principles, CMOS fabrication, digital and analog IC building blocks, and FPGA-based realization. Emphasis is placed on hands-on design, simulation, and implementation, making it a skill-oriented course.

Objectives:

1. Understand CMOS fabrication flow and device behavior.
2. Design MOSFET-based digital and analog circuits.
3. Analyze delay, power, and scaling effects in VLSI circuits.
4. Design CMOS combinational and sequential logic.
5. Implement and verify designs using FPGA and EDA tools.

UNIT-I**INTRODUCTION & CMOS FABRICATION**

VLSI design flow and IC technology overview, NMOS, PMOS and CMOS fabrication processes, MOS transistor structure and operation, $I_{DS}-V_{DS}$ and $I_{DS}-V_{GS}$ characteristics, Threshold voltage and body effect, CMOS inverter operation and characteristics, Latch-up in CMOS circuits, MOS layers, stick diagrams, layout concepts, Introduction to design rules

UNIT-II:**BASIC CIRCUIT CONCEPTS & SCALING**

Sheet resistance and its application to MOS devices, Capacitance of MOS structures, Delay modelling and propagation delay, Inverter delay and capacitive loading, Interconnect wiring capacitance, MOS circuit scaling concepts, Scaling models and scaling factors, Short channel effects, Limitations due to power density and noise

UNIT-III:**ANALOG IC BUILDING BLOCKS**

MOSFET regions of operation, MOS small-signal modelling, Biasing techniques in analog ICs, Single-stage amplifiers: Common Source, Common Drain, Common Gate Current sources and current mirrors, Frequency response (introductory level)



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UNIT-IV:**CMOS COMBINATIONAL & SEQUENTIAL LOGIC**

Static CMOS logic design Complementary CMOS circuits, Ratioed logic and pass transistor logic, Design of: Half adder, Full adder, Multiplexer, Decoder. Dynamic CMOS logic: Basic principles, Speed and power trade-offs. CMOS sequential circuits: SR, JK, D flip-flops, Master-slave flip-flops

UNIT-V:**FPGA & ADVANCED VLSI TECHNOLOGIES**

FPGA design flow Basic FPGA architecture (CLB, LUT, interconnect), FPGA technologies and families, Mapping CMOS logic to FPGA, Introduction to advanced VLSI technologies: Giga-scale integration challenges, Short channel effects, High-k metal gate technology, Fin FET and TFET

PRACTICALS (2 Hours per Week)**List of Experiments**

1. **Introduction to EDA Tools**
 - Familiarization with CMOS design and simulation tools
2. **MOSFET Characteristics**
 - Simulation of $I_{DS}-V_{DS}$, $I_{DS}-V_{GS}$ and $I_{DS}-V_{GS}$ characteristics
3. **CMOS Inverter Design**
 - Design and simulation of CMOS inverter
 - Voltage transfer characteristics
4. **Delay and Power Analysis**
 - Delay calculation of CMOS inverter
 - Effect of load capacitance
5. **Analog IC Building Blocks**
 - Design of Common Source amplifier
 - Gain and frequency response analysis
6. **Current Mirror Design**
 - Design and simulation of MOS current mirror
7. **CMOS Combinational Circuits**
 - Design of half adder and full adder
 - Simulation and verification
8. **Sequential Circuits**
 - Design of D flip-flop using CMOS logic
9. **FPGA Implementation**
 - Implementation of combinational logic on FPGA



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10. Mini Design Task

- Design, simulate, and implement a small CMOS / FPGA-based system

HARDWARE REQUIREMENTS

- FPGA development board
 - Spartan-6 / Artix-7 / equivalent
- Power supply
- USB programming cable

EDA / Design Tools

- **Cadence Virtuoso / LTspice / Microwind & DSCH** (any one)
- **Xilinx Vivado** or **ISE Design Suite**

Simulation Tools

- Analog circuit simulator (Spectre / LTspice)
- Digital logic simulator

Operating System

Windows / Linux

TextBook &References:

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell And SholehEshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. Design of Analog CMOS Integrated Circuits by BehzadRazavi, McGraw Hill, 2003
3. Digital Integrated Circuits, Jan M. Rabaey, AnanthaChandrakasan and Borivoje Nikolic, 2nd edition,2016.
4. Introduction to VLSI Circuits and Systems”, John P. Uyemura, John Wiley and Sons, reprint 2009.
5. Integrated Nano electronics: Nano scale CMOS, Post-CMOS and Allied Nanotechnologies Vinod Kumar Khanna, Springer India, 1st edition, 2016.
6. FinFETs and other multi-gate transistors, ColingeJP, Editor New York, Springer,2008



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Course Outcomes: Upon completion of this course, students will be able to:

1. Explain the CMOS fabrication process, MOS device physics, and VLSI design flow.
2. Analyze MOSFET characteristics, inverter behavior, delay, power, and scaling effects.
3. Design and simulate basic analog IC building blocks such as amplifiers and current sources.
4. Design and analyze CMOS combinational and sequential logic circuits using static and dynamic logic techniques.
5. Implement and verify digital VLSI designs using FPGA and modern EDA tools.

Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	1	2	1	1	2	1	2	1	1	3	2
CO2	2	3	3	2	2	1	1	2	2	3	2	1	2	3
CO3	3	2	3	3	2	2	1	1	3	2	2	1	3	2
CO4	2	2	2	3	3	1	1	2	2	2	1	2	2	3
CO5	1	2	2	2	3	2	1	1	2	2	2	1	2	2



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Indian Knowledge Systems in Space, Communication & Electronics (IKS - MANDATORY)

Credits: 0**Assessment: 100**

Semester	L-T-P	Course Code	Branches
VI	2-0-0	7-4- 6-R25M1	EC

Course Objectives

1. To introduce ECE students to the scientific and technological contributions of ancient India related to space, communication, astronomy, and engineering.
2. To create awareness of Indian Knowledge Systems (IKS) as precursors to modern concepts in electronics, communication, satellites, and space technology.
3. To foster pride, ethical responsibility, and innovation rooted in indigenous knowledge traditions.

UNIT-I: Indian Cosmology, Astronomy & Foundations of Space Science

Indian concept of universe (Brahmanda) in Vedas and Upanishads, Development of astronomy in ancient India, Contributions of ancient Indian astronomers to planetary motion, eclipses, and time calculation, Indian systems of time measurement: Nakshatra, Tithi, Paksha, Yuga, Early understanding of Earth's rotation and celestial mechanics, Relevance to modern space science and satellite orbits.

ECE Relevance: Orbital mechanics, reference frames, timing systems, navigation

UNIT-II: Rockets, Flight & Ancient Aerospace Concepts

Early ideas of flight and aerial vehicles in Indian tradition, Study and scientific interpretation of ancient aeronautical texts, Concepts of propulsion and reaction forces, Ancient metallurgical practices and material knowledge for high-temperature applications, Stability and control concepts in early flying systems, Comparison of ancient ideas with modern rockets and launch vehicles

ECE Relevance: Control systems, avionics, embedded systems in aerospace

UNIT-III: Ancient Communication Systems & Signal Concepts

Communication methods in ancient India: sound, light, symbols, messengers, Concept of Nada (sound) and wave propagation, Sanskrit phonetics as a structured and optimized communication system, Temple acoustics and resonance principles, Symbolic representation, encryption, and coded communication in ancient times

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ECE Relevance: Signals and systems, analog communication, wave propagation

UNIT–IV: Navigation, Measurement & Satellite Analogies

Direction finding using celestial bodies (Sun, stars, constellations), Ancient Indian navigation techniques for land and sea travel Traditional systems of measurement: length, time, mass, Instruments such as Shanku (gnomon) and shadow-based measurements, Conceptual comparison with modern navigation systems like GPS and remote sensing.

ECE Relevance: Navigation systems, sensors, remote sensing fundamentals

UNIT–V: Continuity from Ancient Knowledge to Modern Indian Space Program

Evolution of Indian scientific thought from ancient to modern times, Indigenous philosophy behind modern Indian space missions, Overview of India's achievements in space science and satellite technology, Ethical science, sustainability, and societal impact of engineering, Case studies linking ancient insights with modern ECE and space applications

ECE Relevance: Satellite communication, space electronics, system engineering

Text Books :**1. Indian Knowledge System: Concepts and Applications**

Authors: B. Mahadevan, Vinayak Rajat Bhat, R. Venkata Raghavan

Publisher: PHI Learning Pvt. Ltd., New Delhi

Use: Foundational text for Indian Knowledge Systems, astronomy, measurement systems, and continuity of scientific thought.

2. Indian Astronomy: A Source Book

Editors: B. V. Subbarayappa, K. V. Sarma

Publisher: Nehru Centre, Mumbai

Use: Authoritative reference for ancient Indian astronomy, cosmology, and time-keeping systems.

3. Satellite Technology: Principles and Applications

Authors: Anil K. Maini, Varsha Agrawal

Publisher: Wiley India

Use: Modern satellite systems for drawing parallels with ancient navigation and space concepts

References :**1. A History of the Kerala School of Hindu Astronomy**

Author: K. V. Sarma

Publisher: Vishveshvarananda Institute of Sanskrit and Indological Studies, Panjab University

Use: Advanced astronomical models and mathematical foundations.

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2. Science and Technology in Ancient Indian Texts*Authors:* Bal Ram Singh, Nath Girish, Umesh Kumar Singh*Publisher:* Various Academic Publishers*Use:* Multidisciplinary view of ancient Indian science and engineering.**3. History of Science and Technology in India***Author:* G. Kuppuram*Publisher:* South Asia Books*Use:* Contextual historical evolution of Indian scientific knowledge.**4. Introduction to Satellite Communication***Author:* Bruce R. Elbert*Publisher:* Artech House*Use:* Communication and signal concepts .

Course Outcomes (COs) : Upon completion of this course, students will be able to

1. Explain the contributions of ancient Indian scholars to astronomy, cosmology, space science, and time measurement systems.
2. Correlate ancient Indian scientific concepts with modern Electronics and Communication Engineering principles.
3. Analyze ancient texts and knowledge systems using scientific reasoning and engineering perspectives.
4. Appreciate ethical, sustainable, and indigenous approaches to science and technology embedded in Indian Knowledge Systems.
5. Apply interdisciplinary thinking to relate Indian Knowledge Systems with contemporary space, satellite, and communication technologies

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	2	1	1	1	1	-	1	1	-	-	1	-
CO2	-	2	2	1	1	1	-	-	1	1	1	1	2	1
CO3	-	2	3	1	2	1	-	1	1	2	1	1	2	-
CO4	-	-	-	-	-	2	2	2	1	1	-	1	-	-
CO5	1	2	2	2	1	1	1	-	1	1	-	2	2	3


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PE-II-1 CYBER SECURITY**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4-6-R25 E11	EC

Course Overview:

The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course deals with the construction and cryptanalysis of block ciphers, stream ciphers and hash functions. The course defines offers the construction and cryptanalysis of public key ciphers, namely RSA. The key exchange problem and solutions using the Diffie-Hellman algorithm are discussed. Message Authentication Codes (MAC) and signature schemes are also detailed. The course deals with modern trends in asymmetric key cryptography, namely using Elliptic Curves. The course ends with the awareness about different network attacks and precautions to be taken for the security

Course Objectives:

The student should be made to:

1. To know the basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To have the knowledge of security requirements for a network against various threats

UNIT-I

Introduction: OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality

UNIT-II

Public Key Cryptography Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.

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UNIT-III

Authentication And Hash Function: Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

UNIT-IV

Network Security Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

UNIT-V

System Level Security Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

Text Book:

1. William Stallings, “Cryptography And Network Security – Principles and Practices”, Prentice Hall of India, Third Edition, 2003.

References:

1. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
2. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.
3. Charles B. Pfleger, Shari Lawrence Pfleger, “Security in Computing”, Third Edition, Pearson Education

Course Outcomes

1. Understand different encryption techniques
2. Implement basic security algorithms required by any computing system
3. Analyze the vulnerabilities in any computing system to design a security solution
4. Analyze the possible security attacks and their effective countermeasures in real time systems
5. Identify system-level security threats and apply basic intrusion detection and firewall principles



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Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	1	1	-	-	1	-	1	2	1
CO2	2	3	2	1	2	1	-	-	-	-	-	-	2	1
CO3	3	2	3	2	1	1	-	-	-	1	-	1	3	1
CO4	2	2	2	3	1	1	-	-	2	-	1	2	2	1
CO5	2	1	3	2	2	1	1	-	-	1	-	1	2	2



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PE-II-2 NEURAL NETWORKS AND FUZZY LOGIC**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4-6-R25E12	EC

Course Overview:

To master the various fundamental concepts of fuzzy logic and artificial neural networks. This will help you to get sufficient knowledge to analyze and design the various intelligent control systems

Course Objectives:

- 1.This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks.
- 2.It deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components.
- 3.The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.
- 4.The main objective of this course is to provide the student with the basic understanding of neural networks and fuzzy logic fundamentals

Unit – 1

Artificial Neural Networks: Introduction to neural networks, biological neurons, artificial neurons, McCulloch-Pitt's neuron model, neuron modeling for artificial neural systems, feed forward network, perceptron network, Supervised and un-supervised learning.

Learning Rules: Hebbian learning Rule, Perceptron learning Rule, Delta learning Rule, Winner-take-all learning rule, Out-star learning rule.

Unit – 2

Supervised Learning: Perceptrons, exclusive OR problem, single layer perceptron network, multi-layer feed forward networks: linearly non separable pattern classification, delta learning rule for multi perceptron layer, error back propagation algorithm, training errors, ADALINE, introduction to Radial Basis Function Networks(RBFN).

Unit – 3

Un-Supervised Learning: Hamming net, Max net. Winner-take-all learning, counter propagation network, feature mapping, self-organizing feature maps

Applications of neural Algorithms: elementary aspects of applications of character recognition.

Neural Network control applications: Process identification, Basic dynamic learning control architecture.



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Unit – 4

Fundamentals of fuzzy logic and fuzzy sets: Definition of fuzzy set , a-level fuzzy set , cardinality, operations on fuzzy sets: union, intersection, complement, Cartesian product, algebraic sum, definition of fuzzy relation, properties of fuzzy relations, fuzzy composition

Unit – 5

Design of Fuzzy Systems: Components of fuzzy systems, functions of fuzzification, Rule base patterns, Inference mechanisms.

Methods of de-fuzzification: COG, COA, MOM, Weighted average, height methods, Design of Fuzzy Systems for temperature setting of water heater, fuzzy system for control of air conditioner

Text / References Books:

- 1.S.Rajasekaran& G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy logic, and Genetic Algorithms”, PHI, EEE, 2003.
- 2.FakhreddineO.Karry&Clarance De Silva, “ Soft Computing and Intelligent Systems, Design Theory, Tools and Applications”, Pearson, 2009.
- 3.Jacek M Zurada, “ Introduction to artificial Neural Systems”, Jaico Publications.
- 4.Zimmerman, “ Fuzzy Set Theory and its Applications” , Kluwer Academic Publishers.
- 5.Timothy J. Ross, “ Fuzzy Logic with Engineering Applications” ,(McGrawHill).

Course Outcomes:

After successful completion of the course, the student will be In a position to

1. Understand the Biological neural systems and construction of artificial neural systems.
2. Understand and explain different learning rules
3. Understand the concept of pattern classification.
4. Identify the different types of supervised and unsupervised training algorithms.
5. Understand the fundamentals of fuzzy logic and design simple fuzzy inference system for engineering applications

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	1	1	-	2	3	2
CO2	2	3	2	1	1	-	-	-	1	1	-	2	2	2
CO3	2	2	3	1	1	-	-	-	1	1	-	2	3	2
CO4	2	3	3	1	1	-	-	-	1	1	-	2	3	3
CO5	3	2	3	1	1	-	-	-	1	1	-	2	3	3

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PE-II-3 REAL TIME OPERATING SYSTEMS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4-6-R25E13	EC

Course Outline:

In several software applications, especially in embedded application, the operating system is required to support the application to meet the timing constraints. The operating system achieves this by deploying suitable scheduling algorithms. A major problem arises, when the real-time tasks share resources. Priority inversions can take place in this case, unless suitable techniques are deployed. Starting with a brief introduction to real-time operating systems, we first discuss the important real-time task/thread scheduling algorithms and resource sharing protocols. An effort towards standardization of real-time operating systems has come to be known as POSIX-RT. We review POSIX-RT requirements. Besides, we review several commercial and open source real-time operating systems.

Prerequisites: C Programming, Computer Organization and Operating Systems, and Operating Systems.

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware system.
4. To learn the methods of interfacing and synchronization for tasking

UNIT – I

Introduction: Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT – II

Real Time Operating Systems: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

UNIT – III

Objects, Services and I/O: Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem.



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UNIT-IV

Exceptions, Interrupts and Timers: Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT-V

CaseStudiesofRTOS:RTLinux, MicroC/OS-II, VxWorks, EmbeddedLinux, and TinyOS.

TEXT BOOK:

Qing Li, “Real Time Concepts for Embedded Systems”, 2011, Elsevier

REFERENCE BOOKS:

1. Rajkamal, “Embedded Systems- Architecture, Programming, and Design”, 2007, TMH.
2. W. Richard Stevens, Stephan A. Rago, “Advanced UNIX Programming”, 2006, 2nd Edition, Pearson.
3. Dr. Craig Hollabaugh, “Embedded Linux: Hardware, Software and Interfacing”, 2008, 1st Edition, Pearson

Course Outcomes:

1. Understand concepts of Real-Time systems and modeling
2. Recognize the characteristics of a real-time system
3. Understand and develop document on an architectural design of a real-time system
4. Apply concepts of interrupts, exceptions, timers and ISRs .
5. Develop and document Task scheduling, resource management, real-time operating systems and fault tolerant applications of Real-Time Systems.

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	1	-	-	1	2	1
CO2	2	3	2	2	1	1	-	-	-	-	-	1	2	1
CO3	3	2	3	2	2	1	-	-	1	1	-	1	3	2
CO4	2	2	2	3	2	1	-	-	2	-	1	1	2	2
CO5	2	1	3	2	2	1	-	-	1	1	-	1	2	2

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PE-II-4 RADAR ENGINEERING**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4- 6-R25E14	EC

Course Overview:

It is important to understand the concepts of principles of Radar Engineering, Mri radar and practical applications of Radar

Course Objectives: The purpose of the course is

1. To understand the basic principle of radar systems and Doppler and MTI Radar.
2. To know how the detection of Noise and principle of Radar receiver

UNIT I

Introduction To Radar: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram and operation, Applications of Radar, The Radar Equation, Detection of Signals in Noise, Receiver Noise and the Signal to-Noise Ratio, Probability Density Functions- Probabilities of Detection and False Alarm-Integration of Radar Pulses, Radar Cross Section of Targets Radar cross Section Fluctuations- Transmitter Power, Pulse Repetition Frequency- System losses.

UNIT-II

MTI Radar: Introduction to Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

UNIT- III

Pulse Doppler Radar: Tracking with Radar, Mono-pulse Tracking, Conical Scan and Sequential lobing, Limitations to Tracking Accuracy, Low-Angle Tracking: Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars (ADT), Radar Antennas.

UNIT- IV

Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Integrators, Constant-False Alarm Rate Receivers, The Radar operator, Signal Management



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UNIT- V

The Radar Receiver: Receiver noise Figure, Super heterodyne Receiver, Radar Displays.
Applications: Electronic Support Measure (ESM), Electronic Counter Measure (ECM),
Electronic Counter-Counter Measure (ECCM), Stealth Technology

Text Books:

1. Merrill I Skolnik, Introduction to Radar Systems, 3rd edition, TMH, 2003.
2. Principles of Modern radar system, M. H. Carpentier, Artech House, 1998.
3. Radar Technology, Brookner, Eli, Artech House
4. Peyton Z Peebles Jr. (2004), "Radar Principles", John Wiley Inc.,
5. Bahman Zohuri, 'Radar Energy Warfare and the Challenges of Stealth Technology', Springer

E-resources and other digital material

1. <https://ocw.mit.edu/resources/res-ll-003-build-a-small-radar-systemcapable-of-sensing-range-doppler-and-synthetic-aperture-radar-2.imagingjanuary-iap-2011/lecture-notes/http://www.radartutorial.eu/07.waves/wa04.en.html>

Course outcomes

Upon successful completion of the course, the student will be able to:

1. Understand the principles and applications of RADAR
2. Analyze detection of signals in noise, receiver noise, SNR and probability of detection.
3. Demonstrate the Doppler Effect and the concepts of continuous wave radars.
4. Analyze the tracking radar systems and mono pulse radar.
5. Understand radar signal detection in presence of noise and its performance

Mapping of course outcomes with the program objectives:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	1	-	2	1	1	2
CO2	1	1	1	2	-	-	-	-	-	-	2	1	2	3
CO3	2	2	2	2	2	-	-	-	-	1	2	2	2	3
CO4	3	2	3	3	1	-	-	-	-	1	2	2	1	2
CO5	2	1	2	2	1	1	-	-	1	-	1	1	2	1

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PE-III-1 INFORMATION THEORY AND CODING**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4- 6-R25E21	EC

Course Overview:

Information is the source of a communication system, whether it is analog or digital. Information theory is a mathematical approach to the study of coding of information along with the quantification, storage, and communication of information. With the increasing importance in the field of digital communications, the information theory emphasizes basic aspects such as discrete modulation techniques and coding theory. The purpose of this course is to introduce various concepts in information theory, error detection and correction codes. various fundamental concepts of encoding algorithms

Course Objectives:

The student should be made to:

1. Be familiar with the concept of amount of information, entropy, channel capacity
2. To know the different communication channels, channel capacity and relation among them.
3. To understand and analyze the various error-detection and error-correction codes
4. To know the design concepts of cyclic codes, convolution codes

UNIT I

Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Mark off Sources

UNITII:

Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI Encoding of the Source Output, Shannon's Encoding Algorithm. Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm.



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UNIT III

Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga's Theorem, Continuous Channels

UNIT IV

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes, LDPC CODES

Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an $(n-k)$ Bit Shift register, Syndrome Calculation, Error Detection and Correction

UNIT V

Cyclic Codes: Golay Codes, BCH Codes.

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm, TURBO CODES

Text Books:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008
3. Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakash, Wiley India Pvt. Ltd, 2015, ISBN:978-81-265-5305-1

Reference Books:

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering
3. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
4. Information Theory and Coding, K.N. Haribhat, D. Ganesh Rao, Cengage Learning, 2017



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Course Outcomes:

Upon completion of the course, the student should be able to:

1. Describe basic parameters of Information theory.
2. Understanding the concepts of source coding techniques, and Error Control coding techniques
3. Apply knowledge of Information theory and error control coding techniques to solve problems
4. Analyze various source coding and channel coding techniques for error detection and error correction in the information bearing signals
5. Analyze and compare audio and video coding techniques

Mapping of course outcomes with the program objectives:

P O C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1	1	-	-	-	2	-	2	3	3
CO2	3	3	2	2	1	-	-	-	-	2	-	2	2	3
CO3	3	2	2	2	2	3	1	-	1	3	-	3	3	3
CO4	3	2	2	1	2	3	-	-	1	3	-	3	3	3
CO5	2	2	2	2	1	3	-	-	-	2	-	2	2	2

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PE-III-2 DSP ARCHITECTURE AND PROCESSORS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4- 6-R25E22	EC

Course Description:

This course explains fundamental concepts of Digital Signal Processing and implementation of various applications on Advanced Processor. Helps students to understand architecture of advanced Digital Signal Processor and how to program it for signal processing applications

Prerequisite: Students should have an understanding of Microcontroller architecture as well as basic C and assembly language programming skills and basic understanding of discrete time signals and systems

Course Objectives:

1. To describe features and architectural improvements of DSP processors.
2. To introduce addressing modes and instruction description of TMS320C6x processors.
3. To demonstrate data representation in DSP Processors and FIR filters.
4. To demonstrate the usefulness of the adaptive filters and learn techniques of code optimization

Unit 1

Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Unit 2

Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family, TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.



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Unit 3

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment

Unit 4

Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem)

Unit 5

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor, High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

Text book and References:

1. M.Sasikumar, D.Shikhare, RaviPrakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
2. Fayeze Gebali, "Algorithms and Parallel Computing", 1st Edition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, Dror Maydan, Jeff McDonald, "Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman, 2000.
4. Ann Melnichuk, Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press, 2010.
5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands, 2007



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Course Outcomes:

At the end of this course students will be able to

1. Identify and formalize architectural level characterization of P-DSP hardware
2. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment
3. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
4. Implement multi-core DSP programming techniques using threads, shared memory
5. Understanding of major areas and challenges in DSP based embedded systems

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO2	2	3	2	2	1	-	-	-	-	1	-	1	2	1
CO3	3	2	3	2	1	1	-	-	-	1	-	1	3	2
CO4	2	2	2	3	2	1	-	-	2	-	1	1	2	2
CO5	2	1	3	2	2	1	-	-	1	1	-	1	2	2



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PE-III-3 DIGITAL DESIGN THROUGH VERILOG**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4- 6-R25E23	EC

Course Objectives:

This course introduces digital circuit design using Verilog HDL, focusing on modeling, simulation and synthesis of combinational and sequential circuits, with basic FPGA implementation

Course Objectives: The purpose of the course is

1. To understand advanced principles of digital system design.
2. To master Verilog HDL modeling at all abstraction levels.
3. To design complex combinational and sequential systems.
4. To perform functional verification using test benches. To learn FPGA design workflow with constraints and optimization

UNIT-I:

Digital Logic Review & HDL Foundations

Number systems, conversions, error detection codes (Hamming, parity). Boolean algebra, algebraic manipulation, K-map multi-variable reduction, Logic gates, propagation delay, timing hazards, static/dynamic hazards, Introduction to HDL, importance in ASIC/FPGA design, Verilog structure, modules, ports, parameters, Data types: nets, regs, vectors, signed/unsigned, Operators: arithmetic, relational, logical, reduction, bitwise, Abstraction levels: behavioral, dataflow, gate- level, Compilation, simulation phases, event scheduling

UNIT-II

Continuous assignments, delays, multiple drivers, Blocking vs. nonblocking assignments: guidelines and pitfalls, Conditional constructs: case, case x, case z, priority case. Combinational modules: Adders: half, full, ripple-carry, carry-lookahead, Subtractors, multipliers. Multiplexers and demultiplexers, Encoders/decoders, comparators. Arithmetic Logic Unit (ALU) design, ROM/RAM behavioral modeling; memory initialization., Parameterized modules using generate blocks. Synthesizable coding guidelines: latch avoidance, full-case parallel-case

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UNIT- III:

Sequential Circuit Design & FSMs

Flip-flops (SR, JK, D, T), timing parameters, Registers, shift registers (SISO, SIPO, PISO, PIPO), Counters: binary, decade, Johnson, ring counters. Synchronous vs asynchronous resets,. FSM concepts: state diagrams, transition tables. FSM coding styles: one-hot, binary, gray. Sequence detectors (overlapping, non-overlapping).Datapath design: ALU, register file, multiplexed datapath, Pipelining, parallel processing, Clock domain crossing, metastability.

UNIT-IV:

Verification, Testbenches & System Verilog Intro

Types of testbenches: simple, layered, self-checking. Stimulus generation using tasks and functions, File- based I/O operations. Timing controls: delay, event control, wait statements. Functional verification methodology basics. Introduction to System Verilog enhancements: Interfaces, assertions, constraint random testing, Coverage-driven verification basics, Debug waveform analysis

UNIT-V:

FPGA Design Flow & Implementation

FPGA architecture: CLB, LUTs, DSP slices, BRAM.FPGA routing and switching. .Synthesis: Technology mapping, logic equivalence checking .Implementation: placement, routing, bit stream generation Timing constraints using XDC/SDC. Optimization techniques: retiming, register balancing. IP core integration, AXI interfaces. Building a small processor or DSP block. Hardware debugging: Chipscope/ILA

Reference Books

1. Samir Palnitkar, *Verilog HDL: A Guide to Digital Design and Synthesis*, Pearson Education, 2nd Edition, 2003.
2. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, McGraw-Hill Education, 3rd Edition, 2014.
3. Pong P. Chu, *FPGA Prototyping by Verilog Examples: Xilinx Spartan-3 Version*, Wiley-IEEE Press, 1st Edition, 2008.
(Newer editions may be cited as "Latest Edition")
4. Douglas L. Perry, *HDL Synthesis and Modeling*, Springer / Kluwer Academic Publishers, 2nd Edition, 1998.
5. Michael D. Ciletti (commonly used instead of "Readler"), *Advanced Digital Design with the Verilog HDL*, Pearson Education, 2nd Edition, 2011.ITC



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Course Outcomes: After the completion of the course the student will be able to:

1. Explain HDL concepts, modelling types, and digital logic fundamentals.
2. Develop synthesizable Verilog for combinational logic.
3. Design and code sequential circuits and FSMs.
4. Perform simulation and verification using test benches.
5. Implement digital designs on FPGA using industry-standard tools

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	-	-	-	-	-	-	1		2	2	1
CO2	3	3	2	-	-	-	-	-	-	1	-	2	3	2
CO3	2	3	3	2	-	-	-	-	-	1	-	3	3	3
CO4	2	3	3	2	-	-	-	-	-	1	-	3	3	3
CO5	2	2	3	2	-	-	-	-	-	1	-	3	3	3



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PE-III-4 ELECTRONIC SYSTEM PACKAGING**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VI	3-0-0	7-4- 6-R25E24	EC

Course Objectives:

1. The purpose of the course is
2. To understand multi-level packaging technologies
3. To study PCB design, fabrication, and high-speed effects
4. To evaluate component packaging techniques
5. To analyze thermal loads and reliability mechanisms
6. To design EMI/EMC-compliant electronic systems

UNIT-I:

Introduction to packing:

System packaging hierarchy: Level 0-3, Electronic product design cycle, Electrical considerations: signal integrity, crosstalk, Thermal considerations: conduction paths, Material technologies: FR4, ceramic, flex PCBs, Environmental stresses.

UNIT-II:

PCB Design & High-Speed Layout Techniques:

PCB Stack-up engineering, Impedance control: single-ended, differential, Transmission line effects, Grounding: star ground, split ground, High-speed routing: length matching, skew control, Via types: through-hole, blind, buried, microvias

UNIT-III:

Packaging & Interconnect Technologies:

DIP, SMD, QFP, QFN, BGA, Micro BGA. Chip -on-board, flip-chip bonding, Wafer-level packaging. TSV, 2.5D & 3D integration. Soldering processes: reflow, wave.

UNIT-IV:

Thermal Design & Reliability Engineering

Heat sinks, thermal pads, vapor chambers, Cooling: Natural, forced, liquid, Reliability failures: solder fatigue, thermal cycling, Testing: HALT, HASS, thermal shock, JEDEC standards



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UNIT-V:**EMI/EMC in Electronic Packaging**

Sources of EMI, Shielding techniques, Ground loops and prevention, Filtering using ferrite beads, PCB strategies for EMC compliance

Text Books

1. Fundamentals of Microsystems Packaging, R. Tummala, McGraw-Hill Education, **Year: 2001**
2. High-Speed Digital Design: A Handbook of Black Magic, Howard Johnson, Martin Graham, **Publisher: Prentice Hall (Pearson Education), Year: 1993**
3. Electromagnetic Compatibility Engineering, **Author: Henry W. Ott, Publisher: John Wiley & Sons, Year: 2009**

References:

1. Electronic Packaging Reliability, **Author: Michael Pecht, Publisher: CRC Press (Taylor & Francis Group), Year: 1991**
2. Microelectronics Packaging Handbook, R. Tummala, Springer, **Year: 1997**
3. Printed Circuit Board Design Techniques for EMC Compliance, Mark I. Montrose, IEEE Press / Wiley, **Year: 2000**
4. Thermal Management for Electronic Systems, Yogendra Joshi, Pramod Kumar Springer, **Year: 2012**

Course Outcomes: After the completion of the course the student will be able to:

1. Understand packaging fundamentals.
2. Apply PCB design principles.
3. Compare packaging types and interconnects.
4. Analyze thermal management solutions.
5. Implement EMI/EMC techniques

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	-	-	-	-	-	-	1	-	2	2	1
CO2	3	3	2	-	-	-	-	-	-	1	-	2	3	2
CO3	2	3	3	2	-	-	-	-	-	1	-	3	3	3
CO4	2	2	3	3	-	-	-	-	-	1	-	3	3	3
CO5	2	2	2	3	-	-	-	-	-	1	-	3	3	3

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PE-III - 5 INTRODUCTION TO SEMICONDUCTOR MANUFACTURING**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code (7-0-1-01R25)	Branches
VI	3-0-0	7-0-6-R25CE1	CH,CE,EE,EC,ME,CS (All Branches)

Course Overview:

This course deals with semiconductor materials, semiconductor wafer manufacturing and characterization, semiconductor device manufacturing techniques, characterization and advanced processing tools, semiconductor ecosystem and applications.

This course prepares the students to apply their knowledge for designing the processes and manufacturing the equipment and tools for semiconductor device manufacturing in India under the National Semiconductor Mission Programme.

Course Objective(s):

1. To explain the physics of semiconductor materials and devices.
2. To discuss the processes involved in semiconductor manufacturing.
3. To understand the ecosystem of semiconductor manufacturing.
4. To get knowledge of safety aspects in the semiconductor industry.
5. To design systems and equipment for semiconductor manufacturing.

UNIT – 1:**Semiconductor materials (Si, Ge, GaAs, GaN, SiC):**

Electrical classification of solids (metals, semiconductors and insulators), intrinsic and extrinsic semiconductors, crystal structure and defects, band gap and Fermi level, doping effects on electrical conduction in semiconductors, direct and indirect bandgap semiconductors.

UNIT – 2:**Semiconductor wafer manufacturing and characterization:**

Thermal and chemical processes involved in converting pure sand into electronic grade polycrystalline silicon, pure silicon crystal growth from polysilicon, silicon wafer fabrication and polishing.

UNIT – 3:**Thin film fabrication and characterization:**

Vacuum-based thin film deposition techniques for metals, semiconductors and dielectrics; Physical Vapour Deposition (PVD); Chemical Vapour Deposition (CVD); analytical characterization techniques (XRD, SEM, TEM, XPS etc.); plasma, lasers and ion beams for semiconductor manufacturing.



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UNIT – 4:**Semiconductor Device Manufacturing Techniques:**

Introduction to IC-chip manufacturing, oxidation, lithography, etching, doping, diffusion, ion-implantation and metallization, realization of on-chip resistor, diode, capacitor and inductor, bonding and packaging.

UNIT – 5:**Semiconductor ecosystem, safety and applications:**

Clean room aspects, gas handling systems in semiconductor manufacturing, safety aspects in device fabrication (electrical, chemical and vacuum), clean water and pure chemical requirements, CMOS-based IC chips for computers and mobiles, semiconductor-based solar cells and displays, lab-grown diamonds for semiconductor applications.

Textbooks:

1. Sze SM and Lee MK, *Semiconductor Devices: Physics and Technology*, 3rd Edition, Wiley India (2016).
2. Swami Nathan P, *Semiconductor Materials, Devices and Fabrication*, Wiley (2019)

References:

1. Neaman D, *Semiconductor Physics and Devices*, 4th Edition, McGraw Hill (2017).
2. MKS Handbook: *Semiconductor Devices and Process Technology*, 2nd Edition (2017).
3. Gandhi S.K, *VLSI Fabrication Principles: Silicon and Ga-As*, 2nd Edition, Wiley (2008).

Course Outcomes: After completing this course, students will be able to

1. Understand the basic properties and behavior of semiconductor materials used in electronic devices.
2. Learn how semiconductor wafers are manufactured from raw materials to finished silicon wafers.
3. Gain knowledge of thin-film deposition methods and basic material characterization techniques.
4. Understand the main steps involved in semiconductor device and IC fabrication processes.
5. Become familiar with the semiconductor manufacturing ecosystem, safety practices, and major applications of semiconductor devices.



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Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	2	-	2	-	-	-	-	-	-	-	1	3	1
CO3	2	2	-	3	3	-	-	-	-	-	-	1	2	2
CO4	2	2	3	2	2	-	-	-	-	-	-	1	1	1
CO5	1	-	-	-	-	3	2	2	2	1	-	2	2	2



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B. Tech. (Electronics and Communication Engineering)
Semester VII (Fourth Year)

Code		Category	Course Title	Hours/Week			Total	Credits	Marks		
Department	University			L	T	P			CIE	SEE	Total
EC 4701C	7-4-7-01R25	EC-PC	Digital Image and Video Processing	3	0	0	3	3	40	60	100
EC 4702E	7-4-7-R25E1	EC-PE	Professional Elective – IV	3	0	0	3	3	40	60	100
EC 4703E	7-4-7-R25E2	EC-PE	Professional Elective –V	3	0	0	3	3	40	60	100
EC 4704E	7-4-7-R25E3	EC-PE	Professional Elective – VI	3	0	0	3	3	40	60	100
EC 4705O	7-4-7-R25O1	EC-OE	Open Elective – II (MOOCS)	0	0	0	0	3	0	100	100
EC 4706O	7-4-7-R25O2	EC-OE	Open Elective – III (MOOCS)	0	0	0	0	3	0	100	100
EC 4707L	7-4-7-R25P1	EC-PC	Microwave & Optical Communications Lab	0	0	3	3	1.5	40	60	100
EC 4708S	7-4-7-R25S1	EC-SC	Machine Learning	1	0	2	3	2	100	0	100
EC 4709I	7-0-7R25CS	EC-SI	Summer Industrial Internship	0	0	0	0	2	100	0	100
				13	0	5	18	23.5	400	500	900



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ELECTRONICS & COMMUNICATION ENGINEERING**PROFESSIONAL ELECTIVE COURSES**

Professional Elective - I: (V Sem)	7-4-5-R25E11	Computer Organization and Architecture
	7-4-5-R25E12	Electronic Instrumentation (LIM)
	7-4-5-R25E13	Sensors and Actuators
	7-4-5-R25E14	RF Circuit Design
Professional Elective – II (VI Sem)	7-4-6-R25E11	Cyber Security
	7-4-6-R25E12	Neural Networks and Fuzzy Logic
	7-4-6-R25E13	Real Time Operating Systems (RTOS)
	7-4-6-R25E14	Radar Engineering
Professional Elective – III (VI Sem)	7-4-6-R25E21	ITC (Information Theory & Coding)
	7-4-6-R25E22	DSP Architecture and Processors
	7-4-6-R25E23	Digital Design through Verilog
	7-4-6-R25E24	Electronic System Package
	7-0-6-R25CE1	Introduction to Semiconductor Manufacturing
Professional Elective – IV (VII Sem)	7-4-7- R25E11	Satellite Communication
	7-4-7- R25E12	Advanced Programmable Logic Design
	7-4-7- R25E13	Embedded Systems
	7-4-7- R25E14	EV (Alternate Energy sources)
Professional Elective – V (VII Sem)	7-4-7-R25E21	Advanced Communication Networks
	7-4-7-R25E22	Nano Electronics
	7-4-7-R25E23	Wireless Sensor Networks
	7-4-7-R25E24	Quantum Communications
Professional Elective – VI (VII Sem)	7-4-7-R25E31	Hardware and Software Code Design
	7-4-7-R25E32	FPGA
	7-4-7-R25E33	Embedding Sensors and Motors
	7-4-7-R25E34	Cellular and Mobile Communication



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DIGITAL IMAGE AND VIDEO PROCESSING

Credits: 3**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7-01R25	EC

Course Overview:

In this course you will learn the basic principles and tools used to process images and videos, and how to apply them in solving practical problems. Digital images and videos are everywhere these days – in thousands of scientific, consumer, industrial, and creative applications. Which are obtained from a wide range of the electromagnetic spectrum - from visible light and infrared to gamma rays and beyond. The ability to process image and video signals is therefore an incredibly important skill to master for engineering/science students, software developers, and practicing scientists. Digital image and video processing continues to enable the multimedia technology revolution we are experiencing today. This course will strengthen fundamental knowledge about digital image and video processing techniques along with mathematical framework to describe and analyze images and videos. Digital image and video processing is used in almost all engineering fields and wide range of applications in industrial automation, medical, agriculture, security, entertainment, education and many more.

Course Objectives:

The student should be made to

1. To know the concept of image fundamentals and mathematical transforms necessary for image Processing
2. To study the image enhancement and segmentation techniques
3. To learn about different color models and image compression procedures
4. To understand fundamentals of Video Coding

UNIT-1:

Digital Image Fundamentals: Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Transforms: Need for image transforms, Fourier transform, 2-D Discrete Fourier transform and its properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform.



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UNIT –II

Image Enhancements and Filtering: Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain.

Sharpening filters: first and second derivative, frequency domain filters – low-pass and high-pass filters.

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding –global and adaptive, region-based segmentation.

UNIT –III

Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Shannon Fano coding, Huffman coding, Bit plane coding, Transform coding, Predictive coding, Lossy Predictive coding, JPEG Standards

UNIT –IV

Color Image Processing: Color models– RGB, YUV, HSI; Color transformations–formulation, color complements Video Processing: Video Formation, Perception and Representation, Video capture and display, Analog video raster, Analog color Television systems, Digital video.

UNIT –V

Fundamentals of Video Coding: Inter-frame redundancy, motion estimation techniques – full search fast search strategies, forward and backward motion prediction, frame classification – I, P and B Video sequence hierarchy Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X Video Segmentation: Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts

Text/ Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India. 2nd edition 2004
3. Murat Tekalp, "Digital Video Processing" Prentice Hall, 2nd edition 2015
4. S. Jayaraman, S. Esakkirajan and T. Veera Kumar, "Digital Image processing, Tata Mc Graw Hill publishers, 2009
5. Yao Wang, Jorn Ostermann and Ya Qin Zhang "Video processing and Communications" Prentice Hall Publishers, 2002, ISBN 0-13-017547-1.



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Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Apply mathematical transforms(DFT, DCT, Walsh-Hadamard) for image analysis and processing.
4. Develop algorithms for image compression and coding.
5. Apply basic operations on video and estimate the motion of two-dimensional video

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	-	-	-	-	1	-	2	3	2
CO2	3	3	2	3	3	-	-	-	1	1	-	2	3	3
CO3	2	3	2	2	3	-	-	-	-	1	-	2	3	3
CO4	2	2	1	2	2	-	-	-	-	2	-	2	2	2
CO5	3	3	2	3	3	-	-	-	2	2	1	3	3	3



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MICROWAVE AND OPTICAL COMMUNICATIONS LAB

Credits: 1.5**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	0-0-3	7-4- 7-R25P1	EC

Course Overview:

Electromagnetic waves and Microwave Lab will provide practical understanding on Microwave Bench setup such as Reflex Klystron and operation of various components of the same, Gunn diode and their characteristics. This course also ensures to have practical exposure on Antenna parameters measurements and simulation of the same & optical devices and it's characteristics

Course Objectives:

1. Provide practical understanding of microwave sources such as reflex klystron and Gunn diode oscillators through characteristic analysis.
2. Enable hands-on measurement of microwave components and parameters, including waveguides, VSWR, attenuation, impedance, and directional couplers.
3. Develop skills in antenna testing and measurement, focusing on radiation pattern, gain, and beamwidth evaluation.
4. Introduce the use of modern electromagnetic simulation tools (HFSS) for designing and analyzing microstrip patch antennas.
5. Enhance experimental, analytical, and technical reporting skills required for professional practice in microwave and wireless engineering.

List of Experiments:

1. Reflex klystron characteristics – I
2. Reflex klystron characteristics – II
3. Waveguide parameters
4. VSWR measurements
5. Directional Couplers
6. Gunn diode Oscillator
7. Attenuation Measurement
8. Impedance Measurement
9. Antenna measurements
10. Rectangular Patch antenna Design using HFSS Software.



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Course Outcomes

At the end of the course the students will be able to

1. Explain the operating principles and characteristics of microwave sources such as the reflex klystron **and** Gunn diode oscillator.
2. Measure and analyze waveguide parameters, VSWR, attenuation, impedance, and directional coupler characteristics using standard microwave test setups.
3. Perform antenna measurements and evaluate key parameters such as radiation pattern, gain, and beamwidth.
4. Design and simulate a rectangular microstrip patch antenna **using** HFSS software and interpret simulation results.
5. Demonstrate practical skills in handling microwave instruments, conducting experiments safely, analyzing data, and preparing technical laboratory reports.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	2	2	1	1	1	2	2	1	2	3	2
CO2	3	3	2	3	2	1	1	1	1	2	1	3	3	2
CO3	2	2	3	2	2	1	1	1	2	3	2	3	3	2
CO4	2	2	3	3	3	1	1	1	1	2	2	3	3	3
CO5	3	2	2	2	2	1	1	1	1	2	1	3	2	3

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MACHINE LEARNING

Credits: 2**Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	1-0-2	7-4- 7-R25S1	EC

Course Objectives:

1. Introduce the fundamental concepts, types, and applications of Machine Learning.
2. Provide knowledge of data pre-processing techniques required for effective data analysis
3. Explain supervised and unsupervised learning algorithms and their working principles.
4. Enable students to implement machine learning algorithms for real-world problems.
5. Familiarize students with performance evaluation metrics and model assessment techniques.

UNIT - I Introduction to Machine Learning:

Traditional programming approach vs Machine learning approach, History and Evolution of Machine Learning, Learning by Rote vs Learning by Induction, **Paradigms for ML** - Supervised ML, Unsupervised ML, Reinforcement ML, **Data types in ML** - Quantitative data (Continuous, Discrete), Qualitative data (Structured, Semi structured, Unstructured), Nominal data, Ordinal data, Interval data, Ratio data, Stages involved in Machine Learning, Main challenges of ML, Applications of Machine Learning, **IDE's for ML Programming** - Jupyter Notebook, Spyder, PyCharm, Google Colab R Studio, VS Code, **Basic packages to deal with ML** - Numpy, Scipy, Pandas, Scikit-learn, Matplotlib, Seaborn, **Programming Languages for Machine Learning** - Python, Java, R, JavaScript, C++

UNIT - II Explorative Data Analysis (EDA):

Types of EDA - Univariate Analysis, Bivariate Analysis, Multivariate Analysis, **Data Cleaning** - Data Acquisition, Analyzing the data Dealing with duplicate data, Dealing with missing values, Dealing with outliers **Scaling and Transformations** - Feature Scaling and Transformation, Univariate nonlinear Transformations, **Dimensionality Reduction** - Principal Component Analysis (PCA), **Feature Engineering** - Handling Categorical attributes (One-Hot-Encoding), **Feature Expansion** - Interactions and Polynomials, **Automatic Feature Selection** - Univariate Statistics, Model-Based Feature Selection, Iterative Feature Selection

UNIT - III Supervised Machine Learning:

General architecture of Supervised ML, **Types of Supervised ML** - Classification and Regression, **Different Classification Algorithms** K-Nearest Neighbor(KNN) Classifier,



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Linear Models, Logistic Regression, Naive Bayes Classifiers, Decision Tree Classifier, **Ensemble learning and Decision Trees** - Voting, Bagging and pasting, Random Forests, AdaBoost, Gradient Boosting, Stacking, Support Vector Classifier (SVC) Neural Networks, **Different Regression Algorithms** - K-Neighbors Regressor, Linear Regression, Ridge Regression, Lasso Regression, Polynomial Regression, Support Vector Regressor (SVR), Decision Tree Regressor, Random Forest Regressor.

UNIT - IV Unsupervised Machine Learning –

General architecture of Unsupervised Machine Learning, Challenges in Unsupervised ML, **Clustering** - Introduction to Clustering, Soft clustering vs Hard Clustering, K-Means Clustering algorithm, Centroid-based clustering algorithm, Divisive Clustering and Agglomerative Clustering, DBSCAN

UNIT - V Model Evaluation metrics, Fine tuning the model and Visualizations -

Evaluation Metrics for Classification - Confusion Matrices, Accuracy, Precision, Recall, F1-Score, Precision-recall curves, ROC (Receiver Operating Characteristics) curves, Confusion Matrix, **Evaluation Metrics for Regression** - R^2 , Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), **Evaluation Metrics for clustering** - Adjusted Rand Index (ARI), Normalized Mutual Information (NMI), **Cross Validation** - Cross-Validation in scikit-learn, benefits of cross-validation, stratified k-fold cross validation, **Grid Search**- Simple Grid search, Grid search with cross validation, Randomized search, **Visualization** - Univariate Analysis (Bar plot, Box plot, Count plot, Density plot, Histogram, Pieplot), Bivariate Analysis (Pair plot, Scatter plot, Bar plot, Stacked barplot, Multivariate Analysis (Heat Maps)

Text / References Books:

1. “Introduction to Machine Learning with Python”, Andreas C.Mullerand Sarah Guido,
O'Reilly Publications
2. “Hands-on Machine Learning with Scikit-Learn, Kerasand Tensor Flow”,
Aurelien Geron,
O'Reilly Publications
- 3.“Machine Learning Theory and Practice”, M N Murthy, V S Anantha narayana,
Universities Press (India), 2024



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Reference Books:

1. “Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017
2. “Machine Learning in Action”, Peter Harrington, DreamTech
3. “Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

Course Outcomes: After completion of course, students would be able to:

1. Define machine learning and its different types and understand their applications.
2. Explain the various techniques involved in pre-processing of data for Data Analysis
3. Apply various supervised learning algorithms including decision trees and k-nearest neighbours (k-NN) etc.
4. Implement unsupervised learning techniques, viz., K-means clustering etc.
5. Learn about various performance metrics and explore them in various applications of implementing Machine learning Algorithms.

Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	3	-	2	2	-	-	-	-	-	-	-	-	-

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PE-IV-1 SATELLITE COMMUNICATION**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7- R25E11	EC

Course Overview:

This course will provide you with an in-depth background of satellite communication techniques, modern satellite multiple access, modulation and coding schemes, as well as providing an update on key emerging technologies and future systems

Course Objectives:

1. To enable students to become familiar with satellites and satellite services.
2. Study of satellite orbits and launching.
3. Study of Earth segment and space segment components.
4. Study of satellite access by various users

UNIT I

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

UNIT II

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc

UNIT III

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

UNIT IV

Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions



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Unit -V

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA

Textbooks/ Reference:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications Wiley India. 2nd edition 2002.
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009.
Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2009

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the origin, basic concepts of satellite communications, Categorize look angles, and Discuss launches, launch vehicles and orbital effects in satellite communications
2. Analyze the various satellite subsystems and their functionalities.
3. Understand the effect of Solar Eclipse on satellite
4. Evaluate satellite link design and under specified characteristics
5. Understand the multiple access techniques in satellite communication

Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3	2	1	1	-	-	-	-	-	1	1	1	1
CO2	2	3	1	2	1	-	-	-	-	-	-	-	1	1
CO3	3	2	2	1	1	-	-	-	-	-	1	-	1	1
CO4	2	2	2	1	1								2	2
CO5	2	2	2	1	1								2	2



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PE-IV-2 ADVANCED PROGRAMMABLE LOGIC DESIGN**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7- R25E12	EC

Course Description:

Advanced Programmable Logic Design is an advanced-level course in B. Tech (ECE/EEE/CSE) that focuses on the design and implementation of complex digital systems using programmable logic devices. Introduces modern FPGA and CPLD-based system design methodologies.

Course Objectives:

1. To study FPGA architectures and reconfigurable computing.
2. To develop advanced HDL-based systems
3. To integrate IP cores and soft processors
4. To optimize designs through timing constraints
5. To implement real-time FPGA applications

UNIT-I

FPGA Architecture (Elaborated): LUTs, CLBs, routing fabrics. clocking resources: PLL, MMCM., DSP slices and multiplier blocks, Distributed RAM and BRAM, Configuration technologies: SRAM, antifuse

UNIT-II

Advanced HDL Constructs: FSM advanced coding, Pipelined data path design, resource sharing, Generics & parameters, Retiming and balancing.

UNIT-III

IP Core Integration: Bus systems: AXI, AHB. Processor integration: Micro Blaze, Nios-II. Custom IP creation, HLS (high level synthesis) concepts

UNIT-IV

Timing Constraints & Optimization: SDC/XDC constraints. Timing closure strategies, Critical path reduction, Static timing analysis

UNIT-V

Applications & Soc Development: DSP systems on FPGA, Wireless physical layer blocks, Image processing pipelines. Real-time co-processing modules



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Text Books/ Reference Books

1. Clive “Max” Maxfield, *The Design Warrior’s Guide to FPGAs: Devices, Tools and Flows*, Elsevier / Newnes, 1st Edition, 2004.
2. Wayne Wolf, *FPGA-Based System Design*, Prentice Hall / Pearson Education, 1st Edition, 2004.
3. Pong P. Chu, *FPGA Prototyping by Verilog Examples*, Wiley-IEEE Press, 1st Edition, 2008.
4. Scott Hauck and André DeHon, *Reconfigurable Computing: The Theory and Practice of FPGA-Based Computation*, Morgan Kaufmann (Elsevier), 1st Edition, 2008.
5. Samir Palnitkar, *Verilog HDL: A Guide to Digital Design and Synthesis*, Pearson Education, 2nd Edition, 2003.
6. Douglas L. Perry, *HDL Synthesis and Modeling*, Springer / Kluwer Academic Publishers, 2nd Edition, 1998.
7. Xilinx Inc., *Vivado Design Suite User Guides*, Xilinx Documentation, Latest Edition

Course outcomes:

1. Explain FPGA logic structures.
2. Design complex RTL systems.
3. Integrate IP cores and buses.
4. Analyze timing and optimize.
5. Build real-time SoC systems

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	1	-	2	3	2
CO2	3	3	3	2	2	--	-	-	1	1	-	2	3	3
CO3	3	3	3	2	3	-	-	-	1	2	-	2	3	3
CO4	2	2	2	3	3	-	-	-	1	2	1	3	3	3
CO5	3	3	3	2	3	1	-	-	2	2	1	3	3	3

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PE-IV-3 EMBEDDED SYSTEMS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4- 7- R25E13	EC

Course Description:

This course introduces microcontrollers, embedded C programming, peripheral interfacing, and real-time concepts for designing application-specific embedded systems used in modern electronic products

Course Objectives:

- To introduce embedded architectures and microcontroller fundamentals.
- To teach embedded C programming and peripheral interfacing.
- To understand real-time operating systems and scheduling.
- To develop real-world embedded applications

UNIT-I:

Embedded System Architecture: Definition and characteristics of embedded systems, Embedded system components: processor, memory, I/O, timers, ARM-Cortex-M architecture overview: registers, pipelines, modes, Memory types: ROM, Flash, SRAM, EEPROM. Clock sources and PLL configuration. Embedded development tools: compiler, linker, debugger

UNIT-II:

Embedded C & Peripheral Programming: Embedded C syntax, volatile keyword, bitwise operations. GPIO programming. Timer and counter programming. ADC and DAC interfacing. PWM generation for control systems. Serial communication: UART, SPI, I2C

UNIT-III:

Interfacing Sensors & Actuators: Sensor categories: analog, digital, smart sensors. Interfacing temperature, pressure, humidity, IR, proximity sensors. Motor types: Dc motor, stepper motor, servo motor. Motor driver circuits: H-bridge, L293D, MOSFET drivers. Display interfaces: LCD, OLED, 7-segment. Data acquisition systems

UNIT-IV:

RTOS Concepts: Task creation, scheduling and priorities. Synchronization: semaphores, mutex, message queues. Event flags and mailboxes. Context switching and ISR handling. Real-time scheduling algorithms. Memory management in RTOS. Case study: Free RTOS on ARM Cortex



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UNIT-V:

Embedded Applications & Case Studies: IOT-based embedded systems. Smart home automation. Automotive ECUs and CAN communications. Industrial automation and SCADA. Wearable devices. Mini project examples

Text Books

1. Frank Vahid and Tony Givargis,
Embedded System Design: A Unified Hardware/Software Introduction,
John Wiley & Sons, 3rd Edition, 2019.
2. David E. Simon,
An Embedded Software Primer,
Addison-Wesley Professional, 1st Edition, 1999.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi,
ARM Assembly Language Programming and Architecture,
MicroDigitalEd, 2nd Edition, 2016

References:

1. Shibu K. V.,
Introduction to Embedded Systems,
McGraw-Hill Education, 1st Edition, 2009.
2. Wayne Wolf,
Computers as Components: Principles of Embedded Computing System Design,
Morgan Kaufmann (Elsevier), 4th Edition, 2017.
3. Jonathan Valvano,
Embedded Systems: Introduction to ARM Cortex-M Microcontrollers,
Cengage Learning, 5th Edition, 2019.
4. Raj Kamal,
Embedded Systems: Architecture, Programming and Design,
McGraw-Hill Education, 3rd Edition, 2014

Course outcomes:

1. Explain embedded system architecture and microcontroller components
2. Write embedded C programs for peripherals and I/O handling.
3. Interface sensors, actuators, and communication modules.
4. Apply RTOS concepts for task management.
5. Develop complete embedded applications



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Mapping of course out comes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	1	-	2	3	2
CO2	3	3	3	2	2	--	-	-	1	1	-	2	3	3
CO3	3	3	3	2	3	-	-	-	1	2	-	2	3	3
CO4	2	2	2	3	3	-	-	-	1	2	1	3	3	3
CO5	3	3	3	2	3	1	-	-	2	2	1	3	3	3



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PE-IV-4 ELECTRIC VEHICLES & ALTERNATE ENERGY SOURCES**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7- R25E14	EC

Course Description:

This course introduces the principles of electric vehicles, energy storage systems, power electronics and alternative energy sources, focusing on sustainable transportation and renewable energy applications.

Prerequisites: Power Electronics

Course Objectives: The purpose of the course is

1. To understand electric vehicle architecture and energy flow.
2. To study batteries, BMS, charging systems.
3. To analyze EV motors and drive trains.
4. To explore renewable energy technologies.
5. To integrate alternate energy sources with EV infrastructure

UNIT – I

Introduction to Electric Vehicles; Need for Electric Vehicles; Comparison of ICE Vehicles and Electric Vehicles; Types of Electric Vehicles (BEV, HEV, PHEV, FCEV); Advantages and Limitations of EVs; Applications of Electric Vehicles.

UNIT - II

EV Architecture and Drive Systems

Electric Vehicle Architecture; Major Components of EV; Electric Drive System; Electric Motors for EVs (DC Motor, BLDC Motor, Induction Motor, PMSM); Motor Control Requirements; Transmission System in EVs.

UNIT - III

Energy Storage Systems

Energy Storage Requirements for EVs; Battery Fundamentals; Types of Batteries (Lead Acid, Ni-MH, Lithium-ion); Battery Characteristics (Capacity, SOC, SOH); Battery Management System (BMS); Battery Thermal Management and Safety.



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UNIT - IV

Energy Sources and Power Electronics

Conventional and Renewable Energy Sources for EVs; Solar and Wind Energy for EV Charging; Grid Integration of EVs; Power Electronics in EVs; DC–DC Converters; Inverters; AC–DC Converters; Regenerative Braking System..

UNIT - V

Charging Systems and Future Trends

EV Charging Methods (AC Charging, DC Fast Charging, Wireless Charging); Charging Levels and Standards; EV Charging Infrastructure; Environmental Impact of EVs; Government Policies and Incentives; Future Trends in Electric Vehicles..

Text Books

1. Iqbal Husain, ***Electric and Hybrid Vehicles: Design Fundamentals***, CRC Press (Taylor & Francis Group), 2nd Edition, 2011.
2. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz M. Ebrahimi, ***Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design***, CRC Press (Taylor & Francis Group), 2nd Edition, 2018.
3. Chetan Singh Solanki, ***Solar Photovoltaics: Fundamentals, Technologies and Applications***, PHI Learning Pvt. Ltd., 2nd Edition, 2015

References:

1. Krishnan, ***Electric Motor Drives: Modeling, Analysis, and Control***, Pearson Education, 1st Edition, 2001.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, ***Power Electronics: Converters, Applications, and Design***, John Wiley & Sons, 3rd Edition, 2003.
3. James Larminie and John Lowry, ***Electric Vehicle Technology Explained***, John Wiley & Sons, 2nd Edition, 2012.
4. G. R. Nagpal, ***Power Electronics: Devices, Circuits, and Applications***, Khanna Publishers, 1st Edition, 2008.



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Course Outcomes:

After the completion of the course the student will be able to:

1. Understand the fundamentals, need, and types of electric vehicles and compare them with conventional internal combustion engine vehicles..
2. Explain the architecture, components, and drive systems used in electric vehicles.
3. Analyze different energy storage systems, battery technologies, and the role of Battery Management Systems in electric vehicles.
4. Describe various energy sources for electric vehicles and explain the application of power electronic converters and regenerative braking systems
5. Understand electric vehicle charging methods, infrastructure, environmental impacts, and future trends in electric mobility.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	-	-	-	-	2	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	2	-	-	-	-	-	-	-
CO4	3	3	2	-	2	-	2	-	-	-	-	-	-	-
CO5	2	2	-	-	2	-	3	-	-	-	-	-	-	-



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PE-V-1 ADVANCED COMMUNICATION NETWORKS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4- 7- R25E21	EC

Course Description:

Basic techniques for modeling and analyzing communication networks. Fairness and utility functions, routing, congestion control, pricing, queuing models, loss networks, multi-class queues and scheduling.

Prerequisites: Communication Networks**Course Objectives:**

1. To understand the architecture, layered models, and working principles of modern communication networks including LAN, WAN, MAN, and Internet.
2. To study advanced networking concepts such as routing algorithms, congestion control, QoS, traffic engineering, and network performance analysis.
3. To explain emerging network technologies like Software Defined Networking (SDN), Network Function Virtualization (NFV), MPLS, and cloud networking.
4. To analyze wireless and mobile networks including Wi-Fi, cellular networks (4G/5G), ad-hoc networks, and IoT communication frameworks.
5. To develop skills to design and evaluate secure and scalable networks using modern protocols, tools, and simulation techniques

UNIT-I

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

UNIT-II

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.

Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket Algorithm and its properties.

UNIT-III

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.;

Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management



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UNIT-IV

IP address lookup-challenges. Packet classification algorithms and Flow Identification-Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework

UNIT-V

IPV4, IPV6, IP tunneling, IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS

Text Books :

1. Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Verlag, 2001.
3. Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.
4. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
5. George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand advanced concepts in Communication Networking.
2. Design and develop protocols for Communication Networks.
3. Understand the mechanisms in Quality of Service in networking.
4. Evaluate active queue management and admission control techniques.
5. Optimize the Network Design.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	1	1	-	2	3	2
CO2	3	3	2	3	2	-	-	-	1	2	-	2	3	3
CO3	3	3	3	3	2	-	-	-	1	2	1	3	3	3
CO4	3	3	2	3	3	1	--	1	1	2	1	3	3	3
CO5	3	3	3	2	3	1	1	1	2	2	1	3	3	3

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PE-V-2 NANO ELECTRONICS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7-R25E22	EC

Course Overview:

This course covers specialized topics in modern Nano electronics. It offers an introduction to electron transport in Nano scale semiconductor devices as well as an introduction to magnetism and spintronics. Models for Nano scale transistors and quantum effects in these will be treated

Course Objectives:

This course is aimed to:

1. Make them understand various advanced concepts in Nano electronics.
2. Explore the fundamentals on QED, SED, molecular electronics, and spintronics.
3. Train the students on state of the art computational tools for modelling and simulation of nano electronics devices.

UNIT I

Introduction: Evolution of science and nanotechnology, Introduction to nanotechnology, Difference between Nano science and nanotechnology, Feynman predictions on Nano technology, Role of up and top down approaches in nanotechnology, challenges in nanotechnology.

UNIT II

Molecular Nanotechnology: Electron microscope – scanning electron microscope – atomic force microscope – scanning tunnelling microscope – Nano manipulator – Nano tweezers – atom manipulation – Nano dots – self-assembly – dip pen nanolithography.

UNIT III

Nano powders-Synthesis and processing of Nano powders-process for producing ultrafine powders-mechanical milling, wet chemical synthesis, gas condensation process, chemical vapour condensation, laser ablation, Design and synthesis of self-assembled nanostructured materials.



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UNIT-IV:

Nano Materials: History of Materials, Definition, classification of Nanostructured Materials, cause of interest in Nanomaterial's, Nanomaterial's preparation-present and future applications of Nano materials, special nanomaterial's, characterization and tools: carbon nanotubes, Nano composites, carbon fullerenes: An overview of preparation, properties, Electron microscopy techniques: scanning Electron Microscopy, Transmission Electron Microscopy, scanning probe Microscopy-X ray Methods

UNIT-V

Nano Electronics-Introduction to micro, Nano fabrication: optical lithography, Electron beam lithography, Atomic lithography, Molecular beam Epitaxy, MEMS-Introduction, principles, Types of MEMS:-Mechanical, Thermal, Magnetic MEMS, Fabrication of MEMS

Text /Reference Books:

1. Nano Materials by A S Edelstein& R C Cammarata, Institute of physics publishing, Bristic and Philadelphia
2. Nanotechnology by Mark Ratner & Danier Ratner, Prentice Hall.
3. Micro Manufacturing and Nano technology by N.P.Mahalik.
4. G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009.
5. W. Ranier, Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
6. K.E. Drexler, Nano systems, Wiley, 1992

Course outcomes

Upon successful completion of the course, the student will be able to:

1. Understand various aspects of Nano-technology and the processes involved in making Nano-components and material.
2. Leverage advantages of the Nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of Nano-technology and the processes involved in making Nano-components and material.
4. Leverage advantages of the Nano-materials and appropriate use in solving practical problems.
5. Understand nano-electronics and MEMS fabrication techniques and their applications



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Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	1	1	1	-	2	3	1
CO2	3	3	2	2	2	-	-	1	1	2	1	2	3	2
CO3	3	3	2	3	2	1	-	1	1	2	1	3	3	3
CO4	3	3	2	3	3	1	1	2	2	2	1	3	3	3
CO5	3	3	3	2	3	1	1	2	2	2	1	3	3	3



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PE-V-3 WIRELESS SENSOR NETWORKS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4- 7-R25E23	EC

Course Objectives

1. To understand the architecture, components, and applications of wireless sensor networks, including sensor nodes, communication models, and network topologies.
2. To study communication protocols and standards used in wireless sensor networks, such as MAC, routing, and transport protocols.
3. To analyze energy-efficient design techniques for sensor nodes and networks to enhance network lifetime.
4. To understand data aggregation, localization, and time synchronization techniques used in wireless sensor networks.
5. To evaluate performance and security challenges in wireless sensor networks and study their solutions for real-world applications.

Unit -1

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

Unit -2

Overview of sensor network protocols: Routing / Network layer protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, Fundamentals of IEEE 802.15.4, ZigBee, Bluetooth, BLE (Bluetooth low energy), and UWB, Dissemination protocol for large sensor network

Unit -3

Data dissemination and processing: Data dissemination, data gathering, and data fusion, Quality of a sensor network, differences compared with other database management systems, data storage, query processing, Real-time traffic support and security protocols.

Unit -4

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication, Single-node architecture, Hardware components & design constraints



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Unit -5

Programming tools: Operating systems and execution environments, introduction to TinyOS, C, and nesC, Performance comparison of wireless sensor networks simulation. Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network

Text/ Reference Books:

1. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications, 2011.
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009.
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications, 2004.
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science.
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009.

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for different applications under consideration.
2. Understand emerging research areas in the field of sensor networks.
3. Understand MAC protocols used for different communication standards used in WSN.
4. Explore new protocols for WSN.
5. Handle special issues related to sensors like energy conservation and security challenges

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	1	-	-	-	-	-	2	3	1
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	3	3
CO5	2	2	2	2	3	-	-	1	-	-	-	3	2	3


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PE-V-4 QUANTUM COMMUNICATIONS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7- R25E24	EC

Course Description:

This course introduces the principles of quantum communication, including quantum states, qubits, entanglement, and quantum measurement, with emphasis on quantum channels, quantum key distribution(QKD), quantum teleportation, and noise effects. The course provides foundational knowledge for secure communication systems and emerging quantum networking technologies.

Course Objectives

1. To understand the fundamental concepts, architecture, and components of wireless sensor networks and their real-world applications.
2. To study communication protocols and network layers specifically designed for wireless sensor networks.
3. To analyze energy-efficient algorithms and power management techniques to maximize the lifetime of sensor nodes and networks.
4. To understand data aggregation, routing, localization, and synchronization techniques used in wireless sensor networks.
5. To identify security challenges and performance issues in wireless sensor networks and explore suitable mitigation techniques.

UNIT-I

Fundamentals of Quantum Mechanics for Communication Quantum states, qubits, superposition, entanglement, measurement, no-cloning theorem, quantum operators.

UNIT-II

Quantum Information Theory Quantum bits vs classical bits, density matrices, quantum entropy, quantum channels, DE coherence.

UNIT-III

Quantum Communication Protocols BB84, E91, quantum teleportation, superdense coding, quantum key distribution.

UNIT-IV

Physical Realization of Quantum Communication Photon sources, detectors, optical fibers, free-space quantum links, quantum repeaters.



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UNIT-V

Applications and Future Directions Quantum cryptography, quantum networks, satellite-based quantum communication, challenges.

Text Books

1. Quantum Computation and Quantum Information
Michael A. Nielsen and Isaac L. Chuang, **Publisher:** Cambridge University Press
Year: 2010 (10th Anniversary Edition)
2. Quantum Information Theory, Mark M. Wilde, **Publisher:** Cambridge University Press, **Year:** 2013
3. Principles of Quantum Communication Theory, Stephen M. Barnett
Publisher: Oxford University Press, **Year:** 2009

Reference Books

1. Quantum Communication
Nicolas Gisin, Grégoire Ribordy, Wolfgang Tittel, Hugo Zbinden
Publisher: Reviews of Modern Physics / Springer Compilation, **Year:** 2002
2. Introduction to Quantum Optics, Christopher Gerry and Peter Knight
Publisher: Cambridge University Press, **Year:** 2005
3. Quantum Optics, Marlan O. Scully and M. Suhail Zubairy, **Publisher:** Cambridge University Press, **Year:** 1997
4. Satellite Quantum Communications
Robert Bedington, Juan Miguel Arrazola, Alexander Ling
Publisher: Nature Photonics / Springer, **Year:** 2017

Course outcomes :

1. Understand fundamental concepts of quantum communication, including qubits, quantum states, and measurement
2. Explain quantum channels, entanglement, and their role in information transmission
3. Analyze quantum communication protocols such as quantum key distribution and quantum teleportation
4. Evaluate the effects of noise, decoherence and errors in quantum communications systems
5. Apply quantum communication principles to secure communications and emerging quantum networking applications



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Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	2	2	3
CO2	3	3	-	2	1	-	-	-	-	-	-	2	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO4	3	2	2	2	2	-	-	-	-	-	-	2	2	3
CO5	2	2	2	1	1	1	-	1	-	-	-	3	2	3



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PE-VI-1 HARDWARE AND SOFTWARE CODE DESIGN**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7-R25E31	EC

Course Overview:

This course introduces the integrated design of hardware and software for embedded systems, focusing on systems partitioning, co-simulation, and performance optimization for efficient real-time applications

Course Objectives: The purpose of the course is

- To learn HW/SW co-design methodologies.
- To study partitioning techniques.
- To understand co-simulation and co-verification.
- To design SoC architectures.
- To apply co-design in real-world systems

UNIT – I Introduction to HW/SW Co-Design

Motivation for HW/SW co-design in modern embedded systems, Limitations of pure hardware and pure software solutions, Embedded system constraints: performance, power, cost, time-to-market, System-level design methodologies: top-down vs bottom-up, HW/SW interface models: memory-mapped I/O, interrupts, DMA.

Practical examples: Microcontroller vs FPGA-based implementation, Case study: motor control / sensor data acquisition.

UNIT – II HW/SW Partitioning Techniques

Fine-grain vs coarse-grain partitioning, Static vs dynamic partitioning, Partitioning metrics: execution time, power, latency, area, Task graphs and data flow models, Performance estimation and bottleneck identification.

Hands-on emphasis:

Mapping algorithms to CPU vs hardware accelerator, Case study: FIR filter, FFT, image processing block



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UNIT - III Co-Simulation Techniques

Role of co-simulation in system validation, Instruction Set Simulation (ISS), Transaction Level Modelling (TLM) using System C, HDL-C/C++ co-simulation concepts. Mixed abstraction simulation (behavioural + RTL)

Practical examples: Verilog + C co-simulation flow, Functional verification before hardware synthesis,.

.

UNIT – IV Co-Verification and Prototyping Frameworks

Need for co-verification in HW/SW systems, Interface synthesis and verification, Synchronization between software test benches and hardware models, FPGA–processor co-design platforms, Timing, latency, and throughput verification

Case study: FPGA + ARM processor system, Bus protocols (AXI, AMBA – overview)

UNIT – V Applications & Industry Case Studies

DSP HW/SW co-design (filters, codecs), Robotics and automation controllers, Real-time embedded systems, AI/ML accelerators (CPU + GPU + FPGA concept), SoC-based design methodology

Mini case studies: Autonomous systems, Smart cameras, Industrial control systems

Text Books

1. Hardware/Software Co-Design, Author: Wayne Wolf, Publisher: Morgan Kaufmann, Year: 2002
2. **Embedded System Design, Authors:** Frank Vahid, Tony Givargis, **Publisher:** Wiley, **Year: 2002**

References:

1. System-on-Chip Design and Test, **Authors:** M. Keating, P. Bricaud, **Publisher:** Springer, **Year: 2002,**
2. SystemC: From the Ground Up. **Authors:** David C. Black, Jack Donovan, Brian Bunton, **Publisher:** Springer, **Year: 2010.**
3. FPGA-Based System Design **Author:** Wayne Wolf **Publisher:** Prentice Hall **Year: 2004.**
4. Real-Time Systems, **Author:** Jane W. S. Liu, **Publisher:** Prentice Hall, **Year: 2000.**


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Course Outcomes: After the completion of the course the student will be able to:

1. Understand co-design principles.
2. Perform HW/SW partitioning.
3. Use co-simulation techniques.
4. Apply co-verification methods.
5. Develop mixed HW/SW systems.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	2	1	-	-	1	1	2	1	2	3	2
CO2	3	3	3	2	2	-	-	1	1	2	1	2	3	3
CO3	3	3	2	3	2	1	-	1	1	2	1	3	3	3
CO4	3	3	2	3	3	1	1	2	2	2	1	3	3	3
CO5	3	3	3	2	3	1	1	2	2	2	1	3	3	3



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PE-VI-2 FPGA**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4- 7- R25E32	EC

Course Overview:

This course introduces FPGA architecture, programming using HDL, and design flow, with emphasis on implementing and optimizing digital systems for applications in signal processing, communication, embedded systems, and real-time hardware acceleration

Course Objectives: The purpose of the course is

1. To understand FPGA evolution, architectures, and configuration technologies.
2. To learn HDL coding optimized for FPGA resources.
3. To study FPGA tool flow, timing closure, and reconfiguration.
4. To apply FPGA platforms to communication, DSP, control, and AI.
5. To design complete FPGA-based subsystems.

UNIT – I**FPGA Technology Overview**

History and evolution of PLDs → CPLD → FPGA. FPGA configuration technologies: SRAM, Flash Antifuse. Basic logic elements: LUT, FF, carry chains. FPGA vendors overview: Xilinx, Intel, Lattice. Applications: telecom, automotive, aerospace, AI inference.

UNIT – II**FPGA Architecture & On-Chip Resources**

FPGA tile structure: CLB, slice types. Routing resources: switch matrices, segmented routing. Clock networks: BUFG, BUFH, PLL, MMCM. DSP slices: multipliers, MAC units. BRAM, URAM, distributed RAM. High-speed transceivers: GTX, GTH, SERDES

UNIT – III**HDL Coding for FPGA Optimization**

RTL coding guidelines for FPGA synthesis. Pipelining and retiming. Inferring DSP blocks and memory blocks. FSM coding styles matched to FPGA. Shift register and FIFO implementations. Developing AXI interface modules



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UNIT - IV:**FPGA Implementation Flow & Timing Closure**

Synthesis: mapping, technology translation. Implementation: placement & routing. Static Timing Analysis (STA): setup, hold, recovery. Timing constraints: XDC/SDC formats. Clock domain crossing handling. Power optimization strategies. Hardware debugging: ILA, VIO.

UNIT - V:**FPGA Applications & Reconfiguration**

DSP applications: FIR/IIR filters, FFT accelerators. Image processing pipelines. Communication modules: QPSK, OFDM. Motor control on FPGA. Partial and dynamic reconfiguration. Complete mini- project examples.

Text Books

1. FPGA Prototyping by Verilog Examples, Pong P. Chu, **Publisher:** Wiley **Year:** 2018
2. Digital Design and Computer Architecture, David Harris and Sarah Harris **Publisher:** Morgan Kaufmann (Elsevier), **Year:** 2013
3. FPGA-Based System Design, Wayne Wolf, **Publisher:** Prentice Hall **Year:** 2004

References:

1. Advanced FPGA Design, Steve Kilts. **Publisher:** Wiley, **Year:** 2007
2. Reconfigurable Computing, Scott Hauck and André DeHon **Publisher:** Morgan Kaufmann, **Year:** 2010
3. DSP with FPGAs, Uwe Meyer-Baese, **Publisher:** Springer, **Year:** 2014
4. HDL Chip Design, Douglas J. Smith, **Publisher:** Doone Publications **Year:** 2013

Course Outcomes: After the completion of the course the student will be able to:

1. Describe FPGA architecture, logic elements, and routing.
2. Develop synthesizable HDL targeting FPGA features.
3. Apply FPGA implementation flow and timing constraints.
4. Utilize partial/dynamic reconfiguration.
5. Build FPGA-based real-time applications.



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Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2
CO2	2	2	3	2	3	1	1	1	2	2	1	3	3	2
CO3	2	3	3	3	3	1	1	1	1	2	2	3	3	3
CO4	2	2	3	2	3	1	1	1	1	2	2	3	3	3
CO5	2	3	3	2	3	2	1	1	2	3	2	3	3	3



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PE-VI-3 EMBEDDING SENSORS AND MOTORS**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4-7- R25E33	EC

Course Overview:

This course introduces the interfacing and control of sensors and motors in embedded systems, focusing on signal conditioning, motor drivers, control techniques, and real-time applications used in automation, robotics, automotive, and IOT systems

Course Objectives: The purpose of the course is

1. To study sensor physics, types, and characteristics.
2. To learn interfacing techniques for embedded sensors
3. To understand motor technologies used in automation
4. To design driver circuits and closed-loop motor control
5. To integrate sensors and motors into embedded/robotic systems

UNIT - I**Sensor Fundamentals**

Physical principles: resistive, capacitive, inductive sensing. Characteristics: sensitivity, resolution, accuracy, drift. Static and dynamic response. Noise sources and filtering. Smart sensors and calibration

UNIT - II**Interfacing Sensors with Embedded Systems**

Analog sensors and signal conditioning: op-amps, instrumentation amps. ADC interfacing and sampling theory. Digital sensors: I2C, SPI, UART. Temperature sensors: LM35, thermistors, RTDs. Motion sensors: accelerometer, gyroscope, IMU. Environmental sensors: gas, humidity, pressure

UNIT - III**Motor Technologies**

DC motor construction, back EMF. Stepper motors: hybrid, variable reluctance. Servo motors: position control. BLDC motors: commutation methods. PMSM: sinusoidal drive, trapezoidal drive. Motor selection criteria



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UNIT - IV**Motor Drivers & Control Systems**

H-bridge design, MOSFET drivers. PWM generation and speed control. Current sensing for protection. Closed-loop control: PID, PI. FOC basics for PMSM/BLDC. ESC design for drones

UNIT - V:**Integrated Sensor–Motor Systems**

Robotics: wheel encoders, motor control loops. UAVs: stabilization using IMU + BLDC. Industrial automation. Mechatronic systems. Fault detection and predictive maintenance.

Text Books

1. Sensors and Transducers by D. Patranabis, PHI Learning Pvt. Ltd. **Year:** 2011
2. Sensors and Actuators by Ramakant A. Gayakwad Pearson Education, **Year:** 2014
3. Electric Motors and Drives, by Austin Hughes and Bill Drury Elsevier (Newnes) **Year:** 2019
4. Embedded Systems Design by Raj Kamal, McGraw-Hill Education, **Year:** 2015

References:

1. Mechatronics W. Bolton, Pearson Education, **Year:** 2015
2. Modern Control Engineering Katsuhiko Ogata, Prentice Hall **Year:** 2010
3. Brushless Permanent-Magnet and Reluctance Motor Drives by R. Krishnan CRC Press, **Year:** 2010
4. Design with PIC Microcontrollers, John B. Peatman, Prentice Hall, **Year:** 2003.

Course Outcomes: After the completion of the course the student will be able to:

1. To study sensor physics, types, and characteristics.
2. To learn interfacing techniques for embedded sensors.
3. To understand motor technologies used in automation.
4. To design driver circuits and closed-loop motor control.
5. To integrate sensors and motors into embedded/robotic systems.



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Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	1	2	1	1	1	1	2	1	2	2	1
CO2	2	2	3	2	3	1	1	1	2	2	1	3	3	2
CO3	3	3	2	2	2	1	1	1	1	2	2	3	2	3
CO4	2	2	3	2	3	1	1	1	1	2	2	3	3	3
CO5	2	3	3	2	3	2	1	1	3	3	2	3	3	3



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PE-VI-4 CELLULAR AND MOBILE COMMUNICATION**Credits: 3****Assessment: 40 + 60**

Semester	L-T-P	Course Code	Branches
VII	3-0-0	7-4- 7- R25E34	EC

Course Objectives

1. To understand the fundamentals of cellular and mobile communication systems, including evolution, cellular concepts, and system design principles.
2. To analyze mobile radio propagation mechanisms and channel characteristics, such as large-scale and small-scale fading in wireless environments.
3. To study digital modulation, equalization, and diversity techniques used to improve performance in mobile communication systems.
4. To understand speech coding, channel coding, and multiple access techniques employed in modern cellular networks.
5. To gain knowledge of mobile communication standards and satellite systems, including GSM, IMT-2000, and LEO satellite systems.

UNIT-I

Cellular Concept and System Design Fundamentals: Introduction to wireless communication: Evolution of mobile communications, mobile radio systems- Examples, trends in cellular radio and personal communications.

Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and system capacity, trunking and grade of service, Improving Coverage and capacity in Cellular systems

UNIT-II

Mobile Radio Propagation : Free space propagation model, reflection, diffraction, scattering, link budget design, Outdoor Propagation models, Indoor propagation models, Small scale Multipath propagation, Impulse model, Small scale Multipath measurements, parameters of Mobile multipath channels, types of small scale fading, statistical models for multipath fading channels

UNIT-III

Modulation Techniques and Equalization : Modulation Techniques: Minimum Shift Keying, Gauss ion MSK, M-ary QAM, M-ary FSK, Orthogonal Frequency Division Multiplexing, Performance of Digital Modulation in Slow-Flat Fading Channels and Frequency Selective Mobile Channels. **Equalization:** Survey of Equalization Techniques, Linear Equalization, Non-linear Equalization, Algorithms for Adaptive Equalization. Diversity Techniques, RAKE receiver.



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UNIT-IV

Coding And Multiple Access Techniques : Coding: Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec, RS codes for CDPD. Multiple Access **Techniques:** FDMA, TDMA, CDMA, SDMA, Capacity of Cellular CDMA and SDMA.

UNIT-V

Mobile Satellite Systems and Standards : LEO satellite systems - Iridium, Globalstar, ICO and Teledesic systems, comparison, GSM - reference architecture, radio and security aspects, DECT-radio and network aspects, IMT-2000 –radio and network aspects

TextBook:

1. T.S. Rappaport, "Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.
2. Raj Pandya, 'Mobile and personal communication systems and services', PHI edition, 2003.

References:

1. R. Blake, "Wireless Communication Technology", Thomson Delmar, 2003.
2. W.C.Y. Lee, "Mobile Communications Engineering: Theory and applications, Second Edition, McGraw-Hill International, 1998.

Course Outcomes

At the end of the course the students will be able to

1. Explain fundamentals of wireless and mobile communication systems including frequency reuse, handoff interference and capacity.
2. Analyze mobile radio propagation mechanisms and fading characteristics in wireless channels.
3. Evaluate digital modulation and equalization and diversity techniques for mobile communication systems.
4. Analyze coding techniques and multiple access schemes used in cellular systems
5. Understand mobile satellite systems such as GSM, DECT-radio.



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Mapping of course outcomes with program outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	=	-	-	-	-	-	-	-	1	3	2
CO2	3	3	1	2	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	1	3	3
CO4	3	2	2	1	-	-	-	-	-	-	-	2	2	3
CO5	3	2	2	1	-	-	-	-	-	-	-	2	2	3



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B. Tech. (Electronics and Communication Engineering)
Semester VIII (Fourth Year)

Code		Category	Course Title	Hours/Week			Total	Credits	Marks		
Department	University			L	T	P			CIE	SEE	Total
EC 4801PI	7-0-8-R25PS	EC-PWSI	Project Work & Full Semester Internship	0	0	24	24	12	50	50	100
TOTAL				0	0	24	24	12	50	50	100

In the final semester, the student should mandatorily undergo full semester internship and parallelly he/she should ***work on a project with well-defined objectives***. At the end of the semester the candidate shall submit an internship report and its completion certificate in the department. Student is permitted to submit report on the work carried out during the internship as project report provided the internship work is in the discipline of his B.Tech. Program. Internship programs offered by AICTE/APSSDC/NSDC/SWAYAM PLUS /Any State or Central Government organizations involving Industry experts and approved by the concerned BoS/Head/Head of the Institution are also considered equivalent to full semester Internship provided it involves 90 – 120 hours of work. The Internship work area can be in his own discipline or inter-disciplinary (One discipline being his own) or other discipline also. The project work shall be either in the discipline of his own or inter-disciplinary.



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EXIT OPTIONS FOR B.TECH ELECTRONICS AND COMMUNICATION ENGINEERING

**Two months internship in industry or bridge courses mentioned below of 6 to 8
credits on NPTEL – SWAYAM Platform**

Semester	Exit Option	Credits	Additional Credits for exit students	List of exit courses
Sem I & II	U.G Certificate	40	6-8	1. Electronic Circuit Analysis 2. Digital Logic Design 3. Analog Communications 4. Microprocessors and Microcontrollers 5. IC Applications
Sem III & IV	U.G Diploma	43	6-8	1. Digital Communications 2. Digital Signal Processing 3. Microwave and Optical Communications 4. Communication Networks 5. VLSI Design



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