COURSE STRUCTURE (R23)
AND
DETAILED SYLLABUS
(II YEAR)

ELECTRONICS AND COMMUNICATION ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2023-24)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
Accredited by NAAC with "A" Grade and NBA (CSE,ECE, EEE & ME)
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COURSE STRUCTURE AND DETAILED SYLLABUS
B.TECH- ELECTRONICS AND COMMUNICATION ENGINEERING

II Year I Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BSH-MA2104	Random Variables and Stochastic Processes	3	0	0	3
2.	R23BSH-HM2101	Universal Human Values: Understanding Harmony and Ethical Human Conduct	2	1	0	3
3.	R23ECE-ES2101	Signals and Systems	3	0	0	3
4.	R23ECE-PC2101	Electronic Devices and Circuits	3	0	0	3
5.	R23ECE-PC2102	Digital Circuits Design	3	0	0	3
6.	R23ECE-PC2103	Electronic Devices and Circuits Lab	0	0	3	1.5
7.	R23ECE-PC2104	Digital Circuits& Signal Simulation Lab.	0	0	3	1.5
8.	R23CSE-SC2102	Python Programming Lab (Skill Oriented Course)	0	1	2	2
9.	R23BSH-MC2101	Environmental Science (Mandatory Course)	2	0	0	0
		Total	**16**	**2**	**8**	**20**

II Year II Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BSH-HM2201	Managerial Economics & Financial Analysis.	2	0	0	2
2.	R23EEE-ES2202	Linear Control Systems	3	0	0	3
3.	R23ECE-PC2201	Electro Magnetic Waves and Transmission Lines	3	0	0	3
4.	R23ECE-PC2202	Analog Circuit Design	3	0	0	3
5.	R23ECE-PC2203	Micro Processor and Micro Controllers	3	0	0	3
6.	R23ECE-PC2204	Analog Circuit Design Lab	0	0	3	1.5
7.	R23ECE-PC2205	Micro Processor and Micro Controllers Lab	0	0	3	1.5
8.	R23BSH-SC2202	English for Employability Skills (Skill Oriented Course)	0	1	2	2
9.	R23ECE-ES2201	Design Thinking and Innovation	1	0	2	2
		Total	**15**	**1**	**10**	**21**
Honor Course-1						
Community Service Project (During the Summer Vacation after Second Year & Evaluated in III-I Semester)						

II Year–I Semester

Subject Code	Subject Name	L	T	P	C
R23BSH-MA2104	Random Variables and Stochastic Processes	3	0	0	3

Course Objectives:

- Analyze the behavior of different random variables using their probability mass, density, and distribution functions to assess and predict outcomes in a complex scenario.
- Solve moments, variances, and distributions of random variables and apply the Central Limit Theorem.
- Apply joint distributions, compute joint moments, understand properties of bivariate and multivariate Gaussian random variables.
- Analyze random processes, understand stationarity, and compute autocorrelation and cross-correlation functions.
- Analyze spectral characteristics of random processes and evaluate the response of linear systems using power spectral density and autocorrelation functions.

Course Outcomes:

At the end of this course the student will able to

1. Apply the concepts of probability and random variables to calculate distribution and density functions of discrete and continuous random variables.
2. Apply probability theory, distribution properties, and transformation techniques to determine statistical measures for random variables.
3. Develop models using joint distribution and density functions to solve complex problems involving multiple random variables.
4. Analyze random processes to classify them into deterministic and nondeterministic categories based on their characteristics and behavior.
5. Analyze the response of Linear Time-Invariant (LTI) systems with random inputs in frequency domain.

Unit-I

Probability and Random Variables: Concept of Probability, Conditional Probability, Independent Events, Total Probability Theorem, Bayes' Theorem, Discrete Random Variables, Continuous Random Variables, Distribution Functions, Probability Mass and Density Functions, Properties, Bernoulli, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh Random Variables.

Unit-II

Operation On Random Variable: Moments about the Origin, Central Moments, Variance and Skew, Functions of Random Variables, Chebyshev's Inequality, Characteristic Function, Moment Generating Function, Independent Random Variables, Mean and Variance of sum of Random Variables, Distribution & Density of sum of Random Variables, Central Limit Theorem.

Unit-III

Multiple Random Variables: Bivariate Random Variables, Joint Distribution Function, Joint Density Function, Properties, Marginal Distribution Functions, Marginal Density Functions. Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly, Gaussian Random Variables: Two Random Variables case, N Random Variables case, properties.

Unit-IV

Random Processes: Random Variables to Random Processes, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationary and Statistical Independence. First-Order Stationary Processes, Second order

and Wide-Sense Stationarity, Nth-order and Strict- Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties.

Unit-V

Spectral Characteristics of Random Processes: Power Spectral Density, Relationship between Power Density Spectrum and Auto correlation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function. Random Signal Response of Linear Systems: System Response– Convolution, Mean and Mean-squared Value of System Response, Auto correlation Function of Response, Spectral Characteristics of System Response: Power Density Spectrum of Response

Text Books:

1. Probability, Random Variables & Random Signal Principles, PeytonZ.Peebles, TMH,4thEdition,2001.
2. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S.Unnikrisha, PHI,4thEdition,2002.
3. Probability and Random Processes with Applications to Signal Processing, Henry Stark and JohnW.Woods, Pearson Education, 3rdEdition, 2001.

Reference Books:

1. Schaum's Outline of Probability, Random Variables, and Random Processes,1997.
2. An Introduction to Random Signals and Communication Theory, B.P.Lathi, International Textbook, 1968.
3. Probability Theory and Random Processes, P.Ramesh Babu, McGrawHill, 2015.

Subject Code	Subject Name	L	T	P	C
23BSH-HM2101	Universal Human Values: Understanding Harmony and Ethical Human Conduct	2	1	0	3

COURSE OBJECTIVES:

1. Development of a holistic perspective based on value education and right understanding
2. Build harmony in the human being, Outline and strengthening of self-reflection.
3. Develop Harmony in the family and society and interconnectedness with universal human order
4. Make use of mutual fulfillment relate to orders of nature and holistic perception of societal aspects.
5. Integrate the humanistic constitution and humanistic universal order.

COURSE OUTCOMES:

At the end of this course the student will able to

1. Implement elements and process of value education
2. Recognize thoughts, emotions and physical sensations of the self and the body and harmonizing their relationship
3. Analyze human relations and their role in ensuring harmonious society
4. Develop interconnected nature of existence encourages actions that contribute to global peace, justice and sustainability
5. Make use of humanistic constitution, mutual respect and universal human order with holistic technologies

UNIT-I:

Introduction To Value Education: Understanding Value Education- Self-exploration as the Process for Value Education- Continuous Happiness and Prosperity – Basic Human Aspirations - Right Understanding, Relationship and Physical Facility - Happiness and Prosperity – Current Scenario.

UNIT-II:

Harmony In The Human Being: Understanding Human being as the Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self -Understanding Harmony in the Self - Harmony of the Self with the Body.

UNIT-III

Harmony In The Family And Society: Harmony in the Family – Basic Unit of Human Interaction - Values in Human-to-Human Relationship - 'Trust' – Foundational Value in Relationship - 'Respect' – Right Evaluation -Understanding Harmony in the Society -Vision for the Universal Human Order.

UNIT-IV

Harmony In The Nature/Existence: Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence.

UNIT-V

Implications Of The Holistic Understanding – A Look At Professional Ethics: Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models.

TEXTBOOKS

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana,
2. G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi, Publisher : Prabhat Prakashan; 1st edition (1 January 2018); Prabhat Prakashan Pvt. Ltd, New Delhi-110002
4. Small is Beautiful - E. F Schumacher. Blond & Briggs (1973–2010), HarperCollins (2010)
5. Slow is Beautiful - Cecile Andrews, New Society Publishers (1 October 2006)
6. Economy of Permanence - J C Kumarappa, Publisher : Sarva Seva Sangh Prakashan (1 January 2017)
7. India Wins Freedom - Maulana Abdul Kalam Azad, Publisher : Orient BlackSwan; 1st Edition (1 January 1988)
8. Vivekananda - Romain Rolland (English), Publisher : Advaita Ashrama, India; Fourth Impression edition (30 March 2010)

Subject Code	Subject Name	L	T	P	C
R23ECE-ES2101	Signals & Systems	3	0	0	3

Course Objective:

- Introduce fundamental concepts of continuous-time and discrete-time signals & systems.
- Apply Fourier series and Fourier transform techniques for the representation and transformation of continuous time signals.
- Apply the properties, responses, and characteristics of Linear Time Invariant (LTI) systems, including convolution, stability, causality, and spectral densities.
- Apply Laplace and Z- transforms to convert time domain signals into S-domain and Z- domain respectively.
- Apply the principles of sampling, quantization, and analog-to-digital conversion to implement signal encoding techniques (PCM, DPCM, DM, and ADM).

Course outcomes

At the end of this course the student will able to:

1. Apply knowledge of signal representation, operations, and system classification to perform basic operations on continuous and discrete-time signals.
2. Apply the concepts of Fourier Series and Transforms to decompose periodic and aperiodic continuous-time signals into their constituent frequencies.
3. Apply convolution to determine the response of LTI systems to various input signals
4. Apply Laplace and Z-transforms to solve differential and difference equations originating from continuous-time and discrete-time systems, respectively
5. Apply knowledge of sampling, quantization and analog-to-digital conversion methods to implement signal encoding schemes (PCM, DPCM, DM, and ADM).

UNIT- I

Introduction to Signals & Systems: Basic Continuous-Time and Discrete-Time Signals (Step, Impulse, Signum, Rectangular, Ramp, Triangle, Complex Exponential, Sinusoidal and Sinc), Relationship between Impulse, Step and Ramp Signals, Sampling Property of the Unit Impulse Function, Rectangular signal in terms of Step Signals, Basic operations on continuous and discrete time signals, Classification of Signals, Orthogonal and Ortho Normal Signals, Classification of Continuous-Time and Discrete-Time Systems.

UNIT –II

Fourier Representation of Signals: Trigonometric Fourier series and Exponential Fourier series representation of continuous time periodic signals, Dirichlet's conditions, The Continuous Time Fourier Transform of some useful functions, Inverse Fourier transform, properties of Fourier transforms.

UNIT-III

Linear Time Invariant (LTI) Systems: Convolution, Graphical Convolution, Convolution with Impulse and Step Signals, Impulse Response, Response to an Arbitrary Signal, Filter Characteristics of LTI Systems, Distortion less Transmission, Amplitude and Phase Distortions, Quadrature Filter, Hilbert Transform, Unit Step Response of an LTI System, Causality and Stability of LTI Systems,Parseval's Theorem, Energy Spectral Density (ESD), Power Spectral Density (PSD).

UNIT – IV

Laplace & Z Transforms: The Laplace Transform, Constraints on the ROC, The Inverse Laplace Transform, Properties of The Laplace Transform,Analysis of Causality and Stability of LTI Systems Using Laplace Transform, LTI Systems Characterized by Linear Constant-CoefficientDifferential Equations,Analysis of Electric circuits,The z-Transform, constraints on the ROC, z - Transform of some common sequences, Inverse z -Transforms.

UNIT –V

Sampling and Analog-To-Digital Conversion: Sampling Theorem for Band-Limited Signals, The Effect of Under Sampling- Aliasing, Quantization, Non Uniform Quantization,Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM).

Text Books

1. Modern Digital And Analog Communication Systems; International Fourth Edition- B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2ndEdn.
3. Signals & Systems- Narayan Iyer and K Satya Prasad, Cenage Pub.

Reference Books

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
2. Communication Systems- Simon Haykin, 4thEdition; Johj Wiley and Sons
3. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
4. Signals and Systems – K Raja Rajeswari, B VisweswaraRao, PHI, 2009
5. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition,2008.
6. Signals and Systems – T K Rawat , Oxford University press, 2011.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2101	Electronic Devices & Circuits	3	0	0	3

Course Objectives:

- To enable students to understand P-N junction diode characteristics, rectification processes, and the applications of special diodes like Zener Diodes, LEDs, Photo Diodes, and Solar Cells.
- To provide students with an in-depth understanding of the operation, configurations, and characteristics of Bipolar Junction Transistors (BJT) and their applications as amplifiers and switches.
- To provide students with a comprehensive understanding of the construction, operation, and characteristics of Field Effect Transistors (FET), including JFETs and MOSFETs, and their applications in electronic circuits.
- To equip students with the knowledge and skills to understand transistor biasing, thermal stabilization, and perform amplifier analysis using h-parameters.
- To equip students with an understanding of small signal and high-frequency amplifier circuits using BJTs and FETs.

Course Outcomes:

At the end of this course the student will able to

1. Explain the characteristics of P-N junction and special diodes and their role in designing rectifier circuits and basic electronic devices (L2)
2. Apply the characteristics and configurations of Bipolar Junction Transistors (BJT) in designing amplifiers and switches in electronic circuits. (L3)
3. Apply the characteristics of JFETs and MOSFETs in designing electronic circuits (L3)
4. Apply biasing techniques and h-parameter analysis to design and stabilize transistor amplifiers in electronic circuits. (L3)
5. Analyse small signal and high-frequency models of BJTs and FETs to evaluate the gain, bandwidth, and efficiency of amplifier circuits (L4)

UNIT-I

P-N Junction Diode Characteristics & Special Diodes: Qualitative Theory of the P-N junction, Open Circuited P-N Junction, Diode act as a Rectifier, V-I Characteristics and its Temperature Dependence, Current Components in a P-N Diode, Diode Resistance and Diode Capacitance, Piece-Wise Linear Model, Diode Current Equation, Quantitative Analysis of Half-wave and Full-wave Rectifiers With and Without Filters

Special Diodes: Zener Diode, LED, LCD, Photo Diode, Solar Cell.

UNIT-II

Bipolar Junction Transistor (BJT) Characteristics: The Junction Transistor- Operation, Transistor Current Components, Transistor Current Equation, Transistor Configurations, Characteristics of CB, CE and CC Configurations and their Comparison, Early Effect, Punch Through/Reach Through, Transistor as an Amplifier, Ebers-Moll model of a transistor, Large Signal, DC and Small Signal CE Values of Current Gain, Typical Transistor-Junction Voltages, Transistor as a Switch, Transistor Switching Times, Maximum Voltage Rating, Photo Transistor, UJT.

UNIT-III

Field Effect Transistor (FET) Characteristics: The Junction Field-Effect Transistor (JFET)-Types, Construction and Operation, the Pinch-Off Voltage, JFET Characteristics, JFET Parameters, JFET Equivalent Circuits, JFET applications, Comparison Between BJT and JFET, Metal-Oxide-Semiconductor FET (MOSFET)- Types, Construction, Operation and Characteristics, Comparison Between JFET and MOSFET, Introduction to MOS, CMOS and Bi-CMOS Logics, NMOS, CMOS and Bi-CMOS inverter circuits.

UNIT-IV

Transistor biasing, Thermal Stabilization and h-Parameter Amplifier Analysis: Need for Biasing, Operating Point, Load Line Analysis, BJT Biasing- Methods, Fixed Bias, Collector to Base Bias, Self-Bias, Bias Stability, Stabilization Against Variations in V_{BE}, I_C, and β, Stability Factors, (S, S', S''), Bias Compensation, Thermal Runaway, Thermal Stability. Introduction to Two-Port Network, Transistor Hybrid Model, Determination of h-Parameters, Conversion of h-Parameters, Generalized Analysis of Transistor Amplifier using h-parameters.

UNIT-V

Small Signal Transistor Amplifier Circuits: Low Frequency BJT & FET Amplifier Circuits: Analysis of CB, CE and CC Amplifiers using h-Parameter Model, Comparison of BJT Transistor Amplifiers, FET Small Signal Model, Comparison of FET Amplifiers. High Frequency BJT & FET Amplifier Circuits: High-Frequency Transistor Models, Hybrid-π models, CE Current Gain, and Basic High-Frequency Analysis of FET Amplifier Circuits (Common Source and Common Drain).

TEXTBOOKS

1. J. Millman, C.C.Halkias, "Millman's Integrated Electronics", Tata McGraw-Hill, 2nd Edition, 2001.
2. Electronic Devices and Circuits J. B. Gupta S. K. Kataria & Sons, 2009
3. Electronic Devices and Circuits- J. Millman, C. Halkias, Mc-Graw HillEducation(India) Private Limited, Fourth Edition, 2015.

REFERENCE BOOKS

1. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits", Pearson/Prentice Hall, 10th Edition, 2008.
2. Shalivahana N. Suresh Kumar, A. Vallavaraj, "Electronic Devices and Circuits", Tata McGraw Hill (India), 3rd edition, 2007.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2102	Digital Circuits Design	3	0	0	3

Course Objectives:

- To equip students with foundational knowledge in Boolean algebra, number systems, and logic operations for minimizing Boolean functions and designing digital circuits.
- To equip students with the knowledge and skills to design and analyze combinational logic circuits using basic logic gates and components such as adders, multiplexers, and encoders.
- To equip students with a thorough understanding of sequential logic circuits, including latches, flip-flops, registers, and counters, for designing digital systems.
- To provide students with the knowledge to design and implement digital circuits using Finite State Machines (FSMs) and Programmable Logic Devices (PLDs) like CPLDs and FPGAs.
- To introduce students to Hardware Description Language (Verilog) and equip them with the skills to model, simulate, and design digital circuits at gate, behavioural, and structural levels.

Course Outcomes:

At the end of this course the student will able to

1. Apply Boolean algebra, logic operations, and function minimization techniques to design efficient digital circuits
2. Apply combinational logic principles to create digital circuits for arithmetic operations and data handling using adders, multiplexers, and encoders
3. Apply sequential logic techniques to design timing, storage, and control circuits using latches, flip-flops, registers, and counters.
4. Apply FSM design techniques and use Programmable logic devices, CPLDs &FPGAs to implement control and processing circuits in digital systems
5. Analyze the design of combinational and sequential circuits using HDLs.

UNIT I

Boolean algebra, logic operations, and minimization of Boolean functions: Number Systems and Codes, Complements of Numbers, r's Complement and (r-1)'s Complement, Representation of unsigned and signed integers, Floating Point representation of real numbers, Theorems of Boolean Algebra, Realization of functions using universal logic gates, Canonical forms of Boolean Functions, Minimization of Functions using Karnaugh Maps, QM algorithm

UNIT-II

Combinational Logic Circuits: Combinational circuits, Design with basic logic gates, design procedure, adders, subtractors, 4-bit binary adder/ subtractor circuit, BCD adder, carry look- a-head adder, magnitude comparator, multiplexers, demultiplexers, decoders, encoders and priority encoders

UNIT-III

Sequential Logic Circuits: Basic architectural distinction between combinational and sequential circuits, Design procedure, latches, flip-flops, truth tables and excitation tables, timing and triggering consideration, conversion of flip- flops, registers, shift registers, universal shift register, design of synchronous and asynchronous counters, ring counter, Johnson counter.

UNIT-IV

Finite State Machines and Programmable Logic Devices: Types of FSM, capabilities and limitations of FSM, state assignment, Mealy to Moore conversion and vice-versa, reduction of state tables using partition technique, Introduction to logic families, PROM, PLA, PAL,

Realization of circuits using PLD's, basic structure of CPLD and FPGA, advantages of FPGAs.

UNIT-V

Hardware Description Language: Introduction to Verilog- gate level, behavioral level and structural level modeling of logic circuits, specification of logic circuits, hierarchical Verilog Code, Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop, Verilog Operators, using Verilog constructs for storage elements, Blocking and Non-blocking Assignments, Using Verilog Constructs for Registers and Counters.

Textbooks:

1. Morris Mano, Digital Design, 5th Edition, Pearson, 2012.
2. Zvi Kohavi & Niraj K. Jha, Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2009.
3. Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGraw-Hill (Unit V)

Reference Books:

1. Charles H. Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers.
2. ZviKohavi and NirajK.Jha, "Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2ndEdition, Prentice Hall PTR.
4. D.P. Leach, A.P. Malvino, "Digital Principles and Applications", TMH, 7th Edition
5. A. Anand Kumar, Switching Theory and Logic Design, PHI, 3rd Edition, 2013.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2103	Electronic Devices And Circuits Lab	0	0	3	1.5

Course Objectives:

- To understand and apply the operation of CROs (Cathode Ray Oscilloscopes) for accurate waveform measurement and analysis in electronic circuits.
- To develop the ability to analyse and characterize diodes (PN junction and Zener) and their practical applications in circuits like rectifiers and voltage regulators.
- To equip students with the skills to design and analyse transistor-based circuits, including BJT and FET configurations, for amplification, switching, and biasing.
- To introduce students to the frequency response of amplifier circuits and enable them to design and analyse stable circuits using both BJT and FET amplifiers
- To enable students to perform hybrid parameter (h-parameter) analysis of BJTs and explore self-biasing techniques for FET and MOSFET circuits using hardware and simulation tools like PSpice.

Course Outcomes:

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

1. Explain the operation of CROs and their use in measuring and analysing waveforms in electronic circuits. (L2)
2. Apply the characteristics of PN junction and Zener diodes to design rectifier and voltage regulator circuits (L3)
3. Design and implement transistor-based circuits for amplification, switching, and biasing using BJT and FET configurations(L3)
4. Analyze the frequency response of BJT and FET amplifiers and design stable amplifier circuits. (L4)
5. Apply h-parameter analysis to BJTs and design self-bias circuits using FET and MOSFET, utilizing both hardware and PSpice simulation. (L3)

List of experiments (Any Twelve Experiments has to be performed):

1. CRO Operation and its Measurements
2. PN Diode Characteristics (Forward & Reverse Bias - Resistance Calculations)
3. Zener Diode as Voltage Regulator
4. Rectifiers with C-Filter (Half Wave & Full Wave)
5. BJT Characteristics (CB Configuration- Input & Output)
6. UJT Characteristics
7. FET Drain & Transfer Characteristics (Common Source Configuration)
8. Transistor as a Switch
9. Transistor Biasing (Operating Point, Load line analysis)
10. Design and Analysis of Voltage- Divider Bias/Self-Bias Circuit using BJT.
11. Design and Analysis of Self-Bias Circuit Using FET.
12. Frequency Response of Emitter Follower-CC Amplifier
13. Determination of h-Parameters of a given BJT-CE using Hybrid Model.
14. Frequency Response of FET-CS Amplifier

All the experiments shall be implemented using Hardware and Software like Multisim/ PSPICE /PROTEUS or Equivalent EDA Tool.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2104	Digital Circuits& Signal Simulation Lab	0	0	3	1.5

Course Objectives:

- To equip students with the knowledge and skills to design and simulate combinational and sequential logic circuits using digital trainer kits and Hardware Description Language (HDL).
- To enable students to analyze and implement arithmetic and logic functions using basic digital components such as adders, subtractors, decoders, multiplexers, and counters.
- To introduce students to the generation and manipulation of various signals and sequences, and their application in digital signal processing using MATLAB or equivalent software.
- To develop the ability to apply Fourier analysis, including Fourier series and Fourier transform, to analyze and reconstruct signals.
- To provide students with the skills to simulate and analyse digital circuits using HDL and signal processing tasks using MATLAB.

Course Outcomes:

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

1. Design and simulate combinational and sequential logic circuits using HDL and verify their functionality with digital trainer kits. (L3)
2. Design and simulate arithmetic and logic circuits such as full adders, decoders, multiplexers, and counters using HDL and verify their functionality with digital trainer kits. (L3)
3. Analyze and manipulate various signals and sequences, including periodic and aperiodic signals, using MATLAB. (L4)
4. Apply Fourier analysis to compute Fourier series and Fourier transforms for signal analysis and reconstruction using MATLAB (L3)
5. Analyze signal processing operations like convolution, correlation, and noise generation using MATLAB(L4)

LIST OF EXPERIMENTS

PART-A

1. Design a simple combinational circuit with four variables and obtain minimal SOP expression
2. Design full adder & Full Subtractor circuit and verify its functional table.
3. Verification of functional table of 3 to 8-line Decoder
4. Design 4 variable logic function verification using 8 to1 multiplexer.
5. Design and verify the functionality of 2-bit Magnitude Comparator
6. Design and verify the truth tables of D flip Flop using SR flip Flop, T flip Flop using JK flip Flops
7. Design and verify the operation of 4-bit Universal Shift Register for different Modes of operation.
8. Design up counter and down counters
9. Design MOD–8 synchronous counter /asynchronous counters.
10. Verification of functional table of octal to binary encoder
11. Design and verify the functionality of 1 to 8 demultiplexer
12. Design a four-bit ring counter using D Flip–Flops/JK Flip Flop and verify output

Note: Any seven experiments are to be simulated using Hardware Description Language and Digital trainer Kits.

PART B

1. Generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Write a program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings- Plot the discrete spectrum of the signal.
4. Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences. Plot all the sequences.
6. Write a program to find autocorrelation and cross correlation of given sequences.
7. Write a program to verify Linearity and Time Invariance properties of a given Continuous System.
8. Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
10. Compute and plot the Laplace transform of a signal.
11. Compute and plot the Z-transform of a discrete-time signal
12. Calculate and plot the impulse response of an LTI system

Note: Any seven experiments are to be simulated using MATLAB and PYTHON.

Subject Code	Subject Name	L	T	P	C
R23CSE-SC2102	**Python Programming Lab (Skill Oriented Course)**	0	1	2	2

Course Objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to Create practical and contemporary applications using these.

Course Outcomes:

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

1. Implement and debug simple Python programs.
2. Implement Python programs with Conditionals and Loops and functions.
3. Implement Python Lists, Tuples and Dictionaries for representing compound data.
4. Interpret the concepts of Object-Oriented Programming as used in Python
5. 5.Appply the Module Concepts and Packages for Real Time Applications

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Dynamic and Strongly Typed Language, Identifiers, Keywords, Statements and Expressions, Variables, How to Running Python scripts, Basic Data Types, Indentation, Comments, Reading Input, Print Output, Operators, Type Conversions.

Sample Experiments:

1. Demonstrate the python script by running in Interactive and Script Mode.
2. Write a python script to read using input () and display using print () functions.
3. 3.Write a program to swap two numbers without using a temporary variable.
4. Write a Python Program to Convert Celsius To Fahrenheit
5. Write a Python program to compute area of triangle.
6. Write a program to calculate the circumference of the circle
7. Write a Python program to compute distance between two points in a 2-dimensional
8. Coordinate system.
9. Write a Python program that calculates number of seconds in a day
10. Write a python script to make use of all conversion functions.
11. Demonstrate the following Operators in Python with suitable examples. i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Membership Operators vii) Identity Operator.

UNIT-II:

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements.

Functions: Built-In Functions, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Anonymous Functions, Lambda, map, reduce and filter.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a program to find the factorial of a given number
3. Write a Python program to find the given year is leap year or not
4. Write a Program to display all prime numbers within an interval

5. Write a python program to check whether given letter is vowels or not
6. 6.Write a python script to take five subject marks and print the grade for the student.
7. Program to check whether a person is eligible to vote or not
8. Write a Python program to calculate the sum of the first N natural numbers using a while loop. Take N as input from the user.
9. Write a program to take input as integer N and check whether N is Pronic Number or not. (Product of two consecutive numbers is pronic N(N+1): Eg 110 = 10*11)
10. 10.Write a python script to take input as amount in rupees R and find out the least number of notes N that can be possible to store in a Wallet. (Hint Notes: 2000,500,200,100,50,20,10) Eg: R=2589, N=5
11. Write a python script to implement map(), reduce() and filter() functions

UNIT-III

Strings & Data Structures: Strings**,** Lists, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File Handling: Reading and writing files, File modes and file objects

Sample Experiments:

1. Write a program to perform the given operations on a strings
   i) Creating the string ii) slicing the string iii) Delete character in the string
2. Write a program to perform the given operations on a list:
   i) Creating the list ii) slicing in the lists iii) Adding Elements in List iv) Deleting the list elements
3. Write a python script to take two string S1 and S2 and do the following:
   i)Check S1 and S2 are anagrams or not. ii) Check S1 is Sub string of S2 or not. iii)S1 is palindrome or not
4. Write a program to check if a given key exists in a dictionary or not.
5. Write a program to add a new key-value pair to an existing dictionary.
6. Write a program to take input as String S and print frequency of each character in S using List data structure.
7. Write a program to take input as String S contains characters and special symbols, reverse the String S such that special symbols remains at same position. (Eg. S=”m@d#u” , Output=”u@d#m”).
8. Write a python script to take input as String sentence S and print each word count using dictionary.
1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Python program to compute the number of characters, words and lines in a file.

UNIT-IV:

Object Oriented Programming OOP in Python: Classes, 'self- variable', Methods, Constructor, Inheritance, Polymorphism, and Data Abstraction.

Errors and Exceptions: Syntax Errors, Exceptions, Exception Handlers,

Sample Experiments:

1. Write program on create classes and objects.
2. Write a program on Default constructors, constructor with parameters
3. Write a program on class variables and instance variables.
4. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.
5. Write a Python program to create a person class. Include attributes like name, country and date of birth. Implement a method to determine the person's age.

6. Write a Python program to create a class representing a shopping cart. Include methods for
7. adding and removing items, and calculating the total price.
8. Using Python OOPS, create a class, constructor, method, __str__ and __repr__ for
9. Employee, Student
10. Write a python program to implement Exceptions hierarchy.
11. Write a program to Catching Specific Exceptions in Python Python program to try with else clause.

UNIT-V

Modules: Creating modules, import statement, from import statement, random, Math, JSON, date, Request, RegEx. **Packages:** Introduction to PIP, Installing packages using PIP.

Introduction to Data Science: NumPy, Pandas,MatplotLib

1. Write a python script to take input as multi-line string and find the sum of all numbers in that string using re module. (Eg. S="he11o they are 40students in97 room of 4th line" , Sum= 152)
2. Using RegEx object check whether given phone number, email address and password is valid or not.
3. Python program to check whether a JSON string contains complex object or not
4. Using date module, write a python script to take input as Date of birth (DOB) and current date(CD) and print age of the person.
5. Python Program to demonstrate NumPy arrays creation using array()function.
6. Python script to load data sets.
7. Write a python script to create a data frame.
8. Python program to demonstrate use of ndim, shape,size,dtype.
9. Using NumPy, implement different matrix operations in python.

APPLICATIONS:

- Web Application Development and Scraping
- Designing Games
- Machine Learning and AI based applications
- Embedded Systems and IoT Applications
- Data Science and Visualization
- Embedded and CAD Applications

Reference Books:

1. Gowri shankar S, VeenaA., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan,2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

https://www.coursera.org/learn/python-for-applied-data-scienceaihttps://www.coursera.org/learn/python?specialization=python#syllabus

Course Code	Course Name	L	T	P	Credits
R23BSH-MC2101	Environmental Science (Mandatory Course)	2	0	0	0

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for futuregenerations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

Course Outcomes:

1. Understand the significance of various natural resources, including renewable, non renewable water, minerals, forests and soil, in the environment and the problems associated with it in maintaining ecological balance and supporting human activities.
2. Apply strategies for mitigating different types of environmental pollution, managing solid waste effectively and adopt individual actions that contribute to pollution prevention and waste reduction.
3. Understand the structure, function, characteristic features of different kind of eco systems, value of biodiversity, threats to bio diversity and India's role and strategies in the conservation of biodiversity for sustainable development.
4. Apply the Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, and Forest Conservation Act to promote sustainable environmental development; Address related social issues and propose effective solutions, delving into the intersection of environmental policies and community welfare to achieve ultimate sustainability goals.
5. Identify the role of information technology in addressing population-related problems**,** focusing on resource management, environmental monitoring, urban planning, healthcare improvement, education to enhance sustainability and quality of life.

UNIT I

Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT II

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution

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, earthquake, cyclone, landslides and e-waste management.

UNIT III

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – 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 ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation : Introduction: Definition: genetic, species and ecosystem diversity – Bio-geographical 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 – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns. Case studies – **Environmental ethics:** Issues and possible solutions – Climate change- global warming, acid rain and ozone layer depletion. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Textbooks:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha forUniversity Grants Commission, Universities Press
2. Palaniswamy, “Environmental Studies”, Pearson education.
3. S. Azeem Unnisa, “Environmental Studies” Academic Publishing Company.
4. K. Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Coursesas per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

References:

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, CengagePublications
2. M. Anji Reddy, “Text book of Environmental Sciences and Technology”, B S Publication.
3. J. P. Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”,Prentice Hall of India Private limited
5. G. R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering andScience, Prentice Hall of India Private limited.

B.Tech II Year - II Semester

Course Code	Course Name	L	T	P	Credits
R23BSH-HM2201	Managerial Economics & Financial Analysis	2	0	0	2

Course Objectives:

- Inculcate the basic knowledge with the concepts of Business, Economics and Finance.
- Analyze various factors of production with proposed theories in relation to cost - volume profit analysis.
- Identify micro environment in which markets operate, how price determination is done under different kinds of competitions and know the different forms of Business organization.
- Asess the best investment decisions by means of time value of money.
- Provide fundamental skills about accounting and explain the process of preparing accounting statements and analysis of financial statements.

Course Outcomes:

1. Equipped with the knowledge of fundamentals of economics, estimating the Demandfor a product, Capable of analyzing Elasticity & Forecasting methods.
2. Apply production concepts, assess the costs and Determine Break Even Point (BEP)of an enterprise for managerial decision making.
3. Identify the influence and price determination of various markets structures and knowledge of the forms of business organization and Business cycles.
4. Analyze how to invest adequate amount of capital in order to get maximum returnfrom selected business activity.
5. Analyze and interpret the process & principles of accounting & apply financial statements for appropriate decisions to run the business profitably.

Unit-I

Introduction to Managerial Economics and demand Analysis: Introduction to Managerial Economics: Definition, Nature and Scope of Managerial Economics– Demand Analysis: Demand Determinants, Law of Demand and its exceptions- Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting- Law of Supply.

Application: Analyze the demand of a product by applying methods of the elasticity of demand.

Unit – II

Theories of Production and Cost Analysis: Production Function – Isoquants and Isocosts, Laws of Returns, Laws of return to Scale, Internal and External Economies of Scale. Cost Analysis: Cost concepts, Opportunity cost, Fixed vs. Variable costs, Explicit costs Vs. Implicit costs, Out of pocket costs vs. Imputed costs, Sunk costs, Historical cost. CVP analysis-Break-even Analysis (BEA) Significance and limitations -Determination of Break Even Point (simple Problems).

Application: Compute contribution, revenue, Cost comparison, Margin of safety for making accuratedecisions related to profitability of particular Enterprise

Unit – III

Introduction to Markets, Pricing & Types of Business Organizations: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Objectives of Pricing- Methods of Pricing: Cost Plus Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Internet pricing.

Types of Business Organizations: Features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company

Application: Analyze the leaps and bounds faced by the service providers in estimation ofpricing in Telecom sector**.**

Unit –IV

Capital and Capital Budgeting: Capital and its significance, Types of Capital, Capital process, Methods and sources of raising finance. Capital budgeting-Meaning and Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR) (Simple problems)

Application: Assess long term investments and funds required in small scale organization**.**

Unit – V

Introduction to Accounting & Financial Analysis:

Accounting objectives, Accounting cycle, GAAP -Double-Entry Book Keeping, Journal, Ledger, Trial Balance-Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simpleadjustments).

Application: Prepare the financial accounting statements like Trading account, Profit and Loss account,Balance sheet of any organization.

Text Books

1. A R Aryasri, "Managerial Economics and Financial Analysis",4th Edition, TMH Publication, 2012.
2. Varshney&Maheshwari, "Managerial Economic Text, problems & Cases", Sultan Chand& Sons Publishers, 2014.

Reference Books:

1. JL Pappas and EF Brigham, "Managerial Economics", Holt-Saunders Publishers, 4th Revised edition, 1st July, 1983.
2. N.P Srinivasn and M. SakthivelMurugan, "Accounting for Management", S. Chand & Publications, 2004.
3. Maheswari S.N., Suneel kK. Maheswari shared K Maheshwari, "An Introduction to Accountancy, Vikas Publishing House, 12th edition, 2018.
4. I.M Pandey, "Financial Management", Vikas Publishing House, 11th Edition, 2015.
5. V. Maheswari K. L. Varshney R.L, "Managerial Economics Text, Problems & Cases", S. Chand & Sons Publications, 2014.

II Year-II Semester

Subject Code	Subject Name	L	T	P	C
R23EEE-ES2202	Linear Control Systems	3	0	0	3

Course Objectives:

1. Understand the fundamental concepts and mathematical modelling of control systems, focusing on feedback, block diagram reduction, and servomotor transfer functions.
2. Understand the time response analysis of first and second-order control systems and the design of P, PI, PD, and PID controllers.
3. Understand the principles of stability analysis in control systems using Routh's stability criterion and root locus techniques.
4. Apply frequency response analysis techniques and compensation methods to evaluate control system stability.
5. Apply state space analysis techniques to analyze the behavior of continuous control systems.

Course Outcomes:

After completing the course, the student should be able to:

1. Apply block diagram techniques to represent control systems and determine the transfer functions of DC, AC servomotors. (L3)
2. Analyze the time response characteristics of first and second-order systems and assess the impact of P, PI, PD, and PID controllers on system behaviour. (L4)
3. Apply Routh's stability criterion to assess the stability of the control system and construct root loci for given systems. (L3)
4. Apply Bode, Nyquist, and Polar plots to assess control system stability (L3)
5. Apply state space methods to assess the controllability and observability of system response (L3)

UNIT I

Control Systems Concepts: Open loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback characteristics, Effects of positive and negative feedback, Mathematical models – Differential equations of translational and rotational mechanical systems and electrical systems, Analogous Systems, Block diagram reduction methods – Signal flow graphs - Reduction using Mason's gain formula. Controller components, DC Servomotor and AC Servomotor-their transfer functions, Synchros.

UNIT II

TimeResponse Analysis: Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants, Study of effects and Design of P, PI, PD and PID Controllers on second order system.

UNIT III

Stability Analysis in Time Domain: The concept of stability – Routh's stability criterion – Stability and conditional stability - limitations of Routh's stability. The Root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

UNIT IV

Frequency Response Analysis: Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram - Stability Analysis from Bode Plots. Polar Plots- Nyquist Plots- Phase margin and Gain margin-Stability Analysis.

Compensation techniques – Study of Effects and Design of Lag, Lead, Lag-Lead Compensator design in frequency Domain on a second order system.

UNIT V

State Space Analysis of Continuous Systems:

Concepts of state, state variables and state model - differential equations & Transfer function models - Block diagrams. Diagonalization, Transfer function from state model, solving the Time invariant state Equations- State Transition Matrix and it's Properties. System response through State Space models. The concepts of controllability and observability, Duality between controllability and observability.

Textbooks:

1. Modern Control Engineering by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. Control Systems Engineering by I. J. Nagrath and M. Gopal, New Age International (P) Limited Publishers, 5th edition, 2007.

References:

1. Control Systems Principles & Design by M.Gopal, 4th Edition, McGraw Hill Education,2012.
2. Automatic Control Systems by B. C. Kuo and Farid Golnaraghi, John wiley and sons, 8th edition,2003.
3. Feedback and Control Systems, Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, 2nd Edition, Schaum's outlines, McGraw Hill Education,2013.
4. Control System Design by Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Pearson, 2000.
5. Feedback Control of Dynamic Systems by Gene F. Franklin, J.D. Powell and Abbas Emami- Naeini, 6th Edition, Pearson,2010.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2201	Electromagnetic waves and Transmission Lines	3	0	0	3

Course Objectives:

- Understand the fundamental concepts and principles of electrostatics and their applications.
- Understand the principles of magnetostatics and time-varying electromagnetic fields, including Maxwell's equations and boundary conditions.
- Understand the characteristics of electromagnetic waves and their behavior in different media.
- Understand the transmission line equations, parameters, and behavior under different conditions.
- Understand the concepts of transmission line impedance, reflection, VSWR, and matching techniques.

Course Outcomes:

At the end of the course student will be able to

1. Apply electrostatic principles to calculate electric fields, potentials, and capacitance for different charge configurations.
2. Apply magnetostatic principles and Maxwell's equations to solve problems related to magnetic fields and inductance.
3. Analyze wave propagation, reflection, refraction, and electromagnetic wave polarization in various media.
4. Analyze the characteristics and performance of different types of transmission lines
5. Apply λ/8, λ /4, λ/2 transmission line principles to determine impedance and reflection coefficients using the Smith Chart.

UNIT1

ELECTROSTATICS: Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.

UNIT2

MAGNETOSTATICS: Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems. Faraday's Law and Transformer e.m.f, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's equations for time varying fields, Maxwell's Equations in DifferentialFormsandWordStatements.BoundaryConditionsofElectromagneticfields:Dielectric-DielectricandDielectric-ConductorInterfaces,IllustrativeProblems.

UNIT3

EM WAVE CHARACTERISTICS: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves Definition, All Relations between E & H, Wave Propagation in different mediums, Polarization, Illustrative Problems.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, introduction to Poynting Theorem – Applications, Illustrative Problem

UNIT-4

TRANSMISSIONLINES-I: Types, Parameters, T & π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortionless lines, Loading -Types of Loading. Illustrative Problems

UNIT5:

TRANSMISSION LINES – II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. Low loss radio frequency lines and UHF Transmission lines, UHF Lines as Circuit Elements; Impedance Transformations λ/8, λ /4, λ/2 Lines –. Smith Chart – Construction and Applications, Quarter wave transformer, Stub Matching -Single & Double, Illustrative Problems

Textbooks:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics" , Oxford Univ.Press, 4th ed., 2008.
2. William H. Hayt Jr. and John A.Buck, "Engineering Electromagnetics", TMH, 7th ed., 2006.
3. R.K.Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
4. E.C.Jordan &K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India

References:

1. John D. Krauss, "Electromagnetics", McGraw- Hill publications.
2. Electromagnetics, Schaum's outline series, Second Edition, Tata McGraw-Hill publications, 2006.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2202	Analog Circuits Design	3	0	0	3

Course Objectives:

The main objectives of this course are:

- To understand the classification, frequency response, distortion, and coupling methods in multistage amplifiers, and analyze practical amplifier configurations.
- To understand feedback amplifiers, their types, and feedback mechanisms, and to analyze and design various oscillators and feedback circuits.
- To understand the classification and operation of power amplifiers, including various classes (A, B, AB, and C), thermal stability, harmonic distortions, and heat dissipation techniques, while analyzing and designing power amplifier circuits.
- To understand the principles of tuned amplifiers, including Q-Factor and bandwidth, and to analyze the performance of small and large signal tuned amplifiers, cascading effects, and stability in various tuned amplifier configurations.
- To understand and design pulse electronic circuits, including wave shaping, multivibrators, and time base circuits, while analyzing various components such as diode clippers, clampers, Schmitt triggers, and tunnel diodes in practical applications.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Explain the classification, distortion, frequency response, and coupling methods in multistage amplifiers
2. Apply feedback concepts to design different feedback amplifiers and oscillators.
3. Analyze the performance of Class A, B, AB, and C power amplifiers, focusing on distortion, thermal stability, and heat dissipation.
4. Analyze the performance, bandwidth, and stability of tuned amplifiers, focusing on cascading effects, Q-factor, and amplifier configurations
5. Apply design principles to develop pulse electronic circuits that meet given specifications and applications

UNIT-I

Multistage Amplifiers: Classification of amplifiers, distortion in amplifiers, frequency response of an amplifier, step response of an amplifier, methods of coupling, band pass of cascaded stages, analysis of cascaded transistor amplifier, two stage RC coupled amplifier, Darlington pair amplifier, Boot-strap emitter follower, Cascade amplifier, differential amplifier.

UNIT-Il

Feedback Amplifiers & Oscillators:

Feedback Amplifiers: Classification of basic amplifiers**,** Feedback concept, types of feedback, feedback topologies, characteristics of negative feedback amplifiers, generalized analysis of feedback amplifiers, performance comparison of feedback amplifiers, method of analysis of feedback amplifiers.

Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wein bridge oscillators using BJT and FET, generalized analysis of LC oscillators, Hartley and Colpitts oscillators using BJT and FET, crystal oscillator, frequency stability of Oscillators.

UNIT-III

Power Amplifiers: Power Amplifiers: Classification of amplifiers, Class A power Amplifiers, harmonic distortions, Class B amplifier, Push-pull amplifier, Complementary symmetry push pull amplifier, Class AB amplifier, Class-C amplifier, thermal stability and heat sink, distortion in

power amplifiers.

UNIT-IV

Tuned Amplifiers: Introduction, Q-Factor, small signal tuned amplifiers, effect of cascading single tuned and doubled tuned amplifiers on band width, stagger tuned amplifiers, comparison of tuned amplifiers, large signal tuned amplifiers, stability of tuned amplifiers.

UNIT-V

Pulse Electronic Circuits: Wave shaping circuits, diode clippers, diode comparator, diode clampers, astable, mono stable and bi-stable multivibrators using BJT, Schmitt trigger using BJT, Tunnel diode, Blocking oscillator, time base circuits.

Text books:

1. J. Millman, C.C.Halkias, "Millman's Integrated Electronics", Tata McGraw-Hill, 2nd Edition, 2001.
2. Pulse and Digital Circuits- A.Anand Kumar, PHI Learning Private Limited, 2012.

Reference:

1. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits", Pearson/Prentice Hall, 10th Edition, 2008.
2. Electronic Devices and Circuits- S.Salivahanan& N.Suressh Kumar,TMH,3rdEdition, 2012

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2203	Microprocessors and Microcontrollers	3	0	0	3

Course Objectives: students are provided with

- Understand the architecture, operation, and interrupt structure of the 8086 microprocessors.
- Understand the addressing modes and instruction set of the 8086 microprocessors for assembly language programming.
- Understand memory and I/O interfacing techniques with the 8086 microprocessors, including programmable peripheral devices.
- Understand the architecture, instruction set, and programming of the 8051 microcontrollers.
- Understand the architecture, features, and programming of PIC18 and AVR microcontroller families.

Course Outcomes:

Student is able to

1. Interpret the Architecture, Register, Memory organization, and interrupt structure of the 8086 microprocessors. (L2)
2. Apply the instruction set of the 8086 microprocessors to write and execute assembly language programs (L3)
3. Develop Interface memory and I/O devices with the 8086-microprocessor using programmable peripheral interfaces. (L3)
4. Develop embedded applications using the 8051 microcontroller's Timers, Parallel Ports, Serial Ports, and Interrupts with Embedded C programming (L3)
5. Apply programming and interfacing techniques to control external devices using PIC18 and AVR microcontrollers. (L3)

UNIT 1

8086 Microprocessor: Evolution of Microprocessors, Register Organization of 8086, Architecture, Pin Diagram, Memory segmentation and organization, Stack implementation, Interrupt structure of 8086. minimum and maximum mode microprocessor system, Timing diagram and General Bus operation.

UNIT 2

8086 Programming: Addressing Modes, Instruction Set of 8086, Assembly Language Programming: Assembler Directives, Simple programs, Procedures and Macros Program.

UNIT 3

Memory and IO Interfacing 8086: Memory interfacing: Memory ICs used, Memory address decoding for control select generation. IO Interfacing: Programmable Peripheral Interface 8255 and its applications, Programmable Interrupt Controller 8259 with examples, Programmable Communication Interface 8251 USART, DMA Controller 8257, Programmable Keyboard and Display Interface 8279.

UNIT 4

Intel 8051 Microcontroller: Microcontroller vs microprocessor, 8051 Microcontroller Architecture, Microcontroller 8051 pin functions, memory organization- program and data ports, Counters and Timers, Serial Communication, Interrupts, Addressing Modes, Instruction set, Keil based C51 embedded C programming, simple programs and peripheral Interface.

UNIT 5-

Microcontroller Families:(architecture, special features and simple instructions)

PIC18: history, family and features. PIC architecture and assembly language programming, branch, call and time delay loop, PIC I/O Port Programming,

AVR: AVR family, general-purpose registers in the AVR, AVR data memory, using instructions with the data memory, AVR status register, AVR data format and directives, Program counter and Program ROM space in AVR, RISC architecture in AVR, I/O port programming in AVR, I/O bit manipulation programming.

Text Books:

1. Advanced Microprocessors and Peripherals, 3e, K M Bhurchandi, A K Ray, McGraw Hill Education, 2017.
2. The 8051 Microcontroller, 3e, Kenneth J. Ayala, Cengage Learning, 2004
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18- Muhammad Ali Mazidi, Rolind D.Mckinay, Danny causey- Pearson Publisher 21st Impression.
4. The AVR microcontroller and Embedded Systems, using Assembly and C, Muhammad Ali Mazidi, Sarmad Naimi, sepehr Naimi, pearson, 2011.

References:

1. The Intel Microprocessors: Architecture, Programming and Interfacing, Barry B.Brey, PHI, 6th Edition.
2. Microprocessors and Interfacing, 2e, Douglas.V.Hall, Tata McGrawhill.
3. Microcontrollers and application, Ajay. V. Deshmukh, Tata McGrawhill,2005
4. Programming and Customizing the PIC Microcontroller, myke predko TMGH, 3e-2008
5. Programming and customizing the AVR microcontroller, Dhananjay v.gadre, McGraw-Hill, 2001.

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2204	Analog Circuits Design lab	0	0	3	1.5

Course Objectives:

- To understand and apply the principles of amplifier design, including two-stage RC-coupled, Darlington pair, cascode, and differential amplifiers.
- To explore the concepts of feedback amplifiers and design various feedback configurations like voltage-series, voltage-shunt, current-series, and current-shunt amplifiers.
- To understand and design different types of oscillators, including RC phase shift, Hartley, and Colpitts oscillators, using BJTs and FETs.
- To analyze and design various classes of power amplifiers, focusing on Class A and Class AB amplifiers, and understand their performance characteristics.
- To design and analyze pulse electronic circuits such as diode clippers, clampers, multivibrators, and Schmitt triggers using BJTs and diodes.

Course Outcomes: The students will be able to

1. Design different types of amplifiers, such as RC-coupled, Darlington pair, cascade, and differential amplifiers(L3).
2. Apply feedback principles to design voltage and current feedback amplifiers for specific applications. (L3)
3. Design various oscillators, including RC phase shift, Hartley, and Colpitts oscillators, ensuring stable frequency generation(L3)
4. Design Class A and Class AB power amplifiers, addressing key aspects like efficiency and thermal stability.(L3)
5. Design pulse electronic circuits, including diode clippers, clampers, multivibrators, and Schmitt triggers using BJTs.(L3)

List of experiments:

1. Design and analysis of Two-Stage RC-Coupled Amplifier
2. Design and Analysis of Darlington Pair Amplifier.
3. Design and Analysis of Cascode Amplifier.
4. Design and analysis of Differential Amplifier.
5. Design and Analysis of Voltage-Series/Voltage-Shunt Feedback Amplifier.
6. Design and Analysis of Current-Series/Current-Shunt Feedback Amplifier.
7. Design and Analysis of RC Phase Shift Oscillator
8. Design and Analysis of LC Heartley/Colpitts Oscillator
9. Design and Analysis of Class A power amplifier
10. Design and Analysis of Class AB amplifier
11. Design and analysis of Single Tuned amplifier.
12. Diode Clippers and Diode clampers
13. Astable and Monostable Multivibrators using BJT
14. Schmitt Trigger using BJT

Minimum 12 Experiments to be performed, All the experiments shall be implemented using Hardware and Software

Subject Code	Subject Name	L	T	P	C
R23ECE-PC2205	Microprocessors and Microcontrollers Lab	0	0	3	1.5

Course Objectives:

- Understand the programming concepts and techniques for arithmetic operations and data manipulation using microprocessors.
- Understand how to interface microprocessors with peripheral devices such as stepper motors, DACs, and interrupt controllers.
- Explore the use of DOS/BIOS functions for input/output operations and display control.
- Understand the interfacing and programming of microcontrollers, particularly the 8051, with various external devices.
- Study the implementation of serial communication, timer functions, and event counting using microcontrollers.

Course Outcomes:

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

1. Develop programs for basic arithmetic operations and data manipulation, including BCD code conversions. (L3)
2. Develop interfacing to control peripheral devices such as stepper motors and DACs using 8255 and 8259 controllers. (L3)
3. Apply DOS/BIOS functions to manage input/output operations and display tasks on 7-segment displays. (L3)
4. Develop the interfacing of 8051 microcontrollers with devices like DC motors, servo motors, and ADCs. (L3)
5. Apply timer functions and interrupts on microcontrollers to manage tasks such as event counting and delay generation. (L3)

List of Experiments

Intel 8086 (16-bit Microprocessor)- Assembly Language Programming using MASM/TASM.

1. Perform simple arithmetic operations.
2. Construct program for Addition of an array of BCD numbers stored in packed form.
3. Implement Sorting an array of random 8-bit binary numbers.
4. Produce the reverse of the given string.
5. Show the Deletion of a Character from a String.
6. Convert ASCII code to packed BCD code.
7. Make use of DOS/BIOS functions to convert BCD code to 7-Segment Display code.
8. Demonstrate the DOS/BIOS functions in reading the key strokes with echo.
9. Utilize 8255 to program the Stepper Motor.
10. Interfacing with a 8259 interrupt controller.
11. Implementation of Digital to Analog converters using 8255.
12. Demonstrate the 8279 Keyboard and Display Interface.
13. 8251 interface to establish serial communication between 8086 and PC.

Intel 8051 (8-bit Microcontroller)- Embedded C Programming experiments using Keil uvision IDE.

1. Demonstrate Delay generation using timer modes.
2. Utilize the timer function and interrupts to count external events.
3. Implement the function of traffic signal model using 8051 microcontrollers.
4. Construct Alphanumeric LCD panel and Hex keypad input interface to 8051.
5. Develop a DC motor interface with 8051 microcontrollers.
6. Model a Servo motor interface with 8051 microcontrollers.
7. Build an Interface of ADC to 8051 microcontrollers.

Course Code	Course Name	L	P	T	Credits
R23BSH-SC2102	English for Employability Skills (Skill Oriented Course)	0	1	2	2

Course Objectives

- Aims to help learners develop their English language skills, particularly those planning to appear for Competitive Exams that test their English Language abilities.
- Gains the power of expression through rich Vocabulary.
- Imparts critical reading strategies for comprehension of complex texts.
- Provides training and opportunities to develop fluency in English through participation in formal group discussions and Self Introductions.
- Demonstrates good writing skills for effective Paragraph Writing, Essay Writing and formal correspondence through emails.
- Encourages the use of a wide range of grammatical structures, Phrases, Clauses and Idioms in speech and writing.

Course Outcomes

1. Enable students to identify Parts of Speech and use them flawlessly, write Emails in formal correspondence effectively, participate confidently by introducing oneself in any formal discussion.
2. Attain Language Proficiency & Accuracy through Contextualized Vocabulary, Verb forms, Tense and subject-verb agreement, produce coherent expressions for professional writing, and introduce themselves unhesitatingly with Task-Based Activities.
3. Develop the fluency and accuracy to write Technical Reports and Emails for professional communication by using appropriate vocabulary and participating confidently in formal discussions.
4. Assimilate lifelong reading habits to comprehend a passage for its gist. Avoid errors in both Speech & Writing and write Letters and Emails for official communication. Realise the technical communicative competence and attainment of grammatically correct structures for formal communication.

Unit I

Vocabulary: How to talk about actions. **Grammar: U**sing and Identifying Parts of Speech accurately**. Writing:** Paragraph Writing and formal correspondence through Emails**. Speaking:** Background to Group discussions & Self-introductions.

Unit II

Vocabulary: How to talk about various speech habits. **Grammar**: Learning Verb forms, Tenses and Subject-verb agreement and using them accurately in both Speaking and Writing contexts. **Writing :** Essay Writing and formal correspondence through Emails. **Speaking:** Four major areas -Subject Knowledge, Oral Communication Skills, Leadership Skills and Team Management-of GD;Real time GDs for Evaluation.

Unit III

Vocabulary: How to insult your enemies**. Grammar:** Sentence Analysis & Synthesis - Voice, Degrees of Comparison, Reported Speech and Types & Forms of sentences. **Writing:** Report writing and Emails for formal correspondence**. Speaking:** Roles in structured GDs; real-time GDs for practising the above roles.

Unit IV

Vocabulary: How to flatter your friends**. Grammar**: Common errors and Correction of Sentences **Reading:** Reading Comprehension passages through Skimming and Scanning and

understanding the gist or the specific purpose of them. **Writing:** Letter writing and Emails. **Speaking:** Advantages of GDs for hiring process; real time GDs for evaluating.

Unit V

Vocabulary & Grammar: High-frequency words for all competitive exams, Clause, Phrase & Idioms**. Reading:** Reading for Comprehending **Writing:** Business Letters and Emails **Speaking:** Group Discussions for Evaluation

Reference Books

1. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
2. Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
3. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
5. Word Power Made Easy by Norman Lewis

ASSESSMENT

The learners will demonstrate their knowledge and abilities through completion of the following required assessments while or at the end of this course. —2 Quizzes, 1 Professional Certificate, 3 Activities on LSRW skills.

Quiz: Quiz is conducted on Grammar & Vocabulary. Each Quiz consists of 50 questions and will be scaled down to 5 Marks. Two quizzes are conducted. One after the 3rd unit, the other, after the last unit. The duration of any quiz is 1hr 30 Min only. These Quizzes are Computer Based Tests (CBT)

Professional Certificate: An International Language Assessment Certificate secured on B1 of the Common European Framework for Reference (CEFR) scale.

Activities on LSRW skills:

Interviews: The candidate has to interview one celebrity of his/her own choice.

The recorded 5-7 min video of the candidate should be uploaded on the ELCS LABLendi Youtube Channel with the help of the concerned English Teacher

The Evaluation Parameters:

- Quality of the Questionnaire(3M)
- Body Language & Confidence of the candidate(5M)
- Youtube likes & Comments(2M)

E-mails:

Each student is required to submit 5 independently written Emails during the course. Specific requirements for each one are accessed on the following Link:
https://docs.google.com/document/d/1IXuzjjmfiOLI23t8xlbLwNefRzIIXi9aOi3XkSHIK_Q/edit?usp=sharing

Listen to Speak:

Students are expected to watch and listen to any one of the 10 given educational video and audio clips to express their point of view. After watching, they will have the opportunity to share their points of view about some of the everyday issues that they can relate to. They have to explain and justify their reasoning to a team of three peers to explore their verbal expressions and their points of view before an External Examiner.

The following is the link to access those clippings:
https://docs.google.com/document/d/1tFuQ_43AVAHKJGVs9AeOODHJTnQMoydqcodSgENaZ3o/edit?usp=drivesdk

Details of Peer Evaluation & Assessment Parameters are available on the following Link: https://docs.google.com/document/d/16l_PUzaOONnjpvMYVzE3XAYUBNhqMK9PbdDOPGIef_8/edit?usp=sharing

Grading:

Assessment Model	Points
Quiz-1	**20**
Quiz-2	**20**
Professional Certificate with B1 or above or Activity of Interview	**20**
E-Mails	**20**
Listen to the Speak Activity	**20**
Total	**100**

Pass Criterion:

1. The student has to Secure 40 Marks to pass this examination
2. A student with a certificate of any International standard of English has to secure a Minimum of 30 Marks in this examination (Certificate+30 Marks) to pass the summative exam.
3. A student who does not have an English Proficiency Certificate has to clear the exam with 40 marks mandatorily.
4. Clearing all categories is mandatory. One needs to get 60% of each category.

Subject Code	Subject Name	L	T	P	C
R23ECE-ES2201	Design Thinking and Innovation	0	1	2	2

Course Objectives:

- To provide a foundational understanding of design elements, principles, and design thinking, along with the application of new materials in industry
- To equip students with the design thinking process and tools for innovation, emphasizing practical application in product development and social innovations
- To explore the role of creativity and innovation in organizations, and to develop the ability to transition ideas into impactful innovations
- To introduce the principles of product design, emphasizing problem-solving, strategic planning, and innovation through case studies and practical applications
- To apply design thinking principles in business processes and innovation, focusing on addressing corporate challenges and developing business models and prototypes for startups

Course Outcomes:

1. 1.Explain the fundamental elements and principles of design, the basics and history of design thinking, and the use of new materials in the industry
2. Apply the design thinking process and tools to develop solutions for driving inventions and social innovations
3. 3.Apply creativity and innovation in organizations to transform ideas into innovations and assess their impact
4. Analyze product design principles to develop strategies, plan specifications, and demonstrate innovative solutions
5. Evaluate design thinking principles to address business challenges, refine business models, and optimize prototypes for startups.

UNIT I

Introduction to Design Thinking: 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.

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, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or 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

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

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Honors Syllabus

Subject Code	Subject Name	L	T	P	C
23ECE-HN2201	Instrumentation Systems and Applications Honors Course-1(Track-1)	3	0	0	3

Course Objectives:

- Introduce sensors of mechanical and electromechanical property for different applications.
- List the different sensors of thermal and magnetic property.
- Introduce to various x-ray and electro analytical property sensors and their functioning.
- Identify the smart sensor principles and recent trends in sensor development.
- Understand the popular pneumatic, hydraulic, mechanical, electrical actuators.

Course Outcomes:

1. Explain the parameters, characteristics and types of mechanical and electromechanical sensors.
2. Understand the various sensors of thermal and magnetic properties and their working.
3. Summarize the sensors working having property of radiation and electroanalytical.
4. Illustrate the design of smart sensors and growth to the future.
5. Outline the working of pneumatic, hydraulic, mechanical and electrical actuators

UNIT-I

Introduction to Sensors: Sensors / Transducers, Principles, Classification, Parameters, Environmental Parameters (EP), Characterization.

Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors, Capacitive Sensors, force/stress using Quartz Resonators, Ultrasonic sensors.

UNIT-II

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index thermosensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermoemf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry – Heat Flux Sensors.

Magnetic Sensors: Sensors and the Principles Behind, Magnetoresistive Sensors, Anisotropic Magnetoresistive Sensing, Semiconductor Magnetoresistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Eddy Current Sensors, Electromagnetic Flowmeter, Switching Magnetic Sensors, SQUID Sensors.

UNIT-III

Radiation Sensors: Introduction, Basic Characteristics, Types of Photosensistors/Photo detectors, X-ray and Nuclear Radiation Sensors, Fiber Optic Sensors.

Electroanalytical Sensors: The Electrochemical Cell, The Cell Potential, Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media, ChemFET.

UNIT-IV

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, The Automation. Film Sensors, Semiconductor IC Technology – Standard Methods, Microelectromechanical Systems (MEMS), Nano-sensors.

Sensor Applications: Introduction, On-board Automobile Sensors (Automotive Sensors),

Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Medical Diagnostic Sensors, Sensors for environmental Monitoring.

UNIT-V

Actuation: Pneumatic and Hydraulic Actuation Systems, Actuation systems, Pneumatic and hydraulic Systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Mechanical Actuation Systems- Types of motion, Kinematic chains, Cams, Gears, Ratchet and pawl, Belt and chain drives, Bearings, Electromechanical Linear actuators. Electrical Actuation Systems- Electrical systems, Mechanical switches, Solid-state switches, Solenoids, D.C. Motors, A.C. motors, Stepper motors, Direct Current Servomotors, Motor selection.

TEXTBOOKS:

1. Sensors and Transducers, D. Patranabis, PHI Learning Private Limited.
2. Mechatronics, W. Bolton, Pearson Education Limited.

REFERENCES:

1. Handbook of Modern Sensors, 3e, Jacob fraden, AIP Press, Springer, 2004
2. Sensor Technology Handbook, Jon S.Wilson Editor, Elsevier, Newnes, 2005.

Subject Code	Subject Name	L	T	P	C
R23ECE-HN2202	Digital Arithmetic Circuits Honors Course-1(Track-1)	3	0	0	3

Course Objective:

- To study digital representation of Various number systems
- To understand the redundant and residue number system and application
- To understand the concept of binary addition, multiplication and division circuits
- To understand concept of floating-point arithmetic
- To understand the concept of floating-point arithmetic circuits

Course Outcome:

At the end of the Course, the Student will be able to:

1. Describe the different representation of number systems
2. Concept of redundant number and residue number system and implementation concept
3. Familiarization of different adder architectures
4. Familiarization of different architectures of multipliers and dividers
5. Familiarization with floating point number representation in digital domain and architectures of floating point circuits

Unit-1

Review of the Number Representation: Numbers and their encodings, Fixed-radix positional number systems, Number radix conversion, Classes of number representations, Signed-magnitude representation, Biased representations, Complement representations, Direct and indirect signed arithmetic.

Unit-2

Redundant Number Systems: Coping with the carry problem, Redundancy in computer arithmetic, Digit sets and digit-set conversions, generalized signed-digit numbers, Carry-free addition algorithms, Conversions and support functions. Introduction to Residue Number systems.

Unit-3

Addition / Subtraction: Bit-serial and ripple-carry adders, Conditions and exceptions, Analysis of carry propagation, Carry completion detection, Manchester carry chains adders. Carry-look-ahead adder design, Ling adder and related designs, Carry determination as prefix computation, Alternative parallel prefix networks, VLSI implementation aspects, Modular two-operand adders

Unit-4

Multiplication: Shift/add multiplication algorithms, Programmed multiplication, Basic hardware multipliers, Multiplication of signed numbers, Multiplication by constants, and Preview of fast multipliers. Radix-4 multiplication, Modified Booth's recoding, Radix-8 and radix-16 multipliers, Multi-bit multipliers, VLSI complexity issues. Full-tree multipliers, Alternative reduction trees, Tree multipliers for signed numbers, Partial-tree and truncated multipliers, Array multipliers, Pipelined tree and array multipliers.

Unit-5

Division: Shift/subtract division algorithms, Programmed division, restoring hardware dividers, Non-restoring and signed division, Division by constants, Radix-2 SRT division. Basics of high-radix division, Using carry-save adders, Radix-4 SRT division, General high radix dividers, Quotient digit selection, Using p-d plots in practice.

Text Books

1. B. Parhami, “Computer Arithmetic: Algorithms and Hardware Designs”, Oxford University Press, 2nd Edition, 2010
2. Koren, Computer Arithmetic Algorithms, Prentice Hall Publications, 2nd Edition, 2003

Reference Books

1. M. D. Ercegovac, Digital Arithmetic, The Morgan Kaufmann Series in Computer Architecture and Design. 1st Edition, 2003.
2. D. A. Patterson and J. L. Hennessy, Computer Organization and Design, Morgan Kaufmann Publishers Inc. San Francisco, 5 th Edition, 2014