III YEAR
I SEMESTER

Engineering Electromagnetics

Subject Code :UGEC5T0122	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisite

- Mathematics – I &II

Course Objective

- To understand and develop various engineering applications involving electromagnetic fields
- To understand foundations of electromagnetism and its practice in modern communications such as wireless, fiber optics and electromagnetic structures

SYLLABUS

UNIT-I **[12 Hrs]**

TRANSMISSION LINES: Types of Transmission lines, Field Distributions of Transmission Lines, Primary and Secondary constants, Transmission Line Equations, Input Impedance of a Transmission line, Lossless line, Types of distortions, condition for distortion-less line, Phase and Group Velocities. RF Lines, Reflection coefficient, Standing wave ratio, Impedance Inverter (λ/4 Line), The Smith Chart, Single stub Matching.

UNIT-II **[15 Hrs]**

ELECTROSTATICS : Coulomb's Law and Field Intensity, Electric Fields Due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law and its Applications, Relationship Between E and V. Energy Density in Electrostatic Fields, Poisson's and Laplace's Equations.

MAGNETO STATICS: Biot-Savart's Law, Ampere's Circuital Law and its Applications, Magnetic Flux Density. Magnetic Vector Potentials, Forces Due to Magnetic Fields.

UNIT-III **[10 Hrs]**

MAXWELL'S EQUATIONS : Convection, Conduction Current and Displacement Current density, Continuity Equation, Faraday‘s Law and Transformer EMF.

Inconsistency of Ampere‘s Law. Maxwell's equations in different forms and word statements. Boundary conditions.

UNIT IV **[12 Hrs]**

EM WAVE CHARACTERISTICS -I Uniform Plane Wave Propagation – lossless dielectrics , Wave Propagation in Lossy Dielectrics, Plane Waves in Free Space, Plane Waves in Good Conductors, Skin Depth, R_{ac}, Polarization, Power and the Poynting Theorem., Surface Impedance.

UNIT V **[8 Hrs]**

EM WAVE CHARACTERISTICS -II Reflection & Refraction of Plane Waves – Normal and Oblique incidence for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and total internal reflection.

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

COS	Description	Bloom's Level
CO 1	Illustrate the characteristics of transmission lines and apply the transmission line parameter concepts for various applications.	II- Understanding
CO 2	Explain the laws and principles of electrostatic and electromagnetic fields	II- Understanding
CO 3	Outline the Maxwell's equations for time varying Electromagnetic fields.	III- Applying
CO 4	Apply the Maxwell's equations for time varying Electromagnetic fields for different media.	III- Applying

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1	3	3	2									2	2	
CO 2	3	3												
CO 3	3	3	3	2								2	2	
CO 4	3	3	3	2								2	2	

Text Books

T1 Mathew N O Sadiku,—Principles of Electromagnetics‖ Oxford University Press, 4th Edition

T2 GSN Raju, "Electromagnetic Field Theory and Transmission lines", Pearson Education, 2013

Reference Books

R1. John D Rider – Networks Lines and Fields – II Edition, PHI 2005

R2. Edward C Jordan, Keith G.Balmain "Electromagnetic waves and Radiating Systems".

DIGITAL DESIGN THROUGH Verilog HDL

Subject Code: UGEC5T0222	L	T	P	C
III Year/ I Semester	3	0	0	3

Prerequisites

- Fundamentals of Analog Electronics
- Digital Logic Design.

Course Objectives

1. To use a computer-aided design tool (Verilog HDL) for development of complex digital logic circuits.
2. To design and Synthesize programmable logics using Verilog HDL.

SYLLABUS

UNIT-I **[12 Hrs]**

Introduction to HDL (Verilog): Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis Tools, Test Bench.

Language Constructs and conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

UNIT-II **[10 Hrs]**

Gate Level Modelling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits.

UNIT-III **[10 Hrs]**

Behavioural Modelling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioural Level.

Blocking and Non-blocking Assignments, The case statement, Simulation Flow. If and if-else constructs, assign-design construct, repeat construct, for loop, the "disable" construct, while loop, forever loop, parallel blocks, force-release construct, Event.

UNIT-IV **[12 Hrs]**

Modelling at Dataflow Level: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

Switch Level Modelling: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Tri-reg Nets.

UNIT-V **[10 Hrs]**

Functions, Tasks, User-Defined Primitives: Introduction, Function, Tasks, User-Defined Primitives (UDP).

Synthesis of Digital Logic Circuit Design: Introduction to Synthesis, Synthesis of combinational logic, Synthesis of sequential logic with latches and flip-flops.

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

COs	Description	Blooms Level
CO1	Explain different design constraints in Verilog HDL	II-Understanding
CO2	Categorize different modelling styles	IV- Analysing
CO3	Model the combinational and sequential circuits using Verilog HDL	VI- Creating
CO4	Illustrate the Synthesis of Digital Logic Circuits	II-Understanding

Mapping of Cos to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1			3		3									
CO 2					3									
CO 3			3		3				3		3	3	3	
CO 4														3

Text Books

T1. T.R.Padmanabhan, B.Bala Tripura Sundari, "Design Through Verilog HDL", John Willly& Sons,INC.,Publication,2004.

T2. Michael, D. Ciletti, "Advanced digital design with the Verilog HDL", Pearson Education India,2002.

Reference Books

R1. Samir Palnitkar, "Verilog HDL" Pearson Education, 2nd Edition, 2009.

R2. J.Basker, "A Verilog HDL Primer" , Star Galaxy Publishing, 3rd Edition

R3. ZainalabdienNavabi, "Verilog Digital System Design", TMH, 2nd Edition.

DIGITAL SIGNAL PROCESSING

Subject Code : UGEC5T0322	**L**	**T**	**P**	**C**
III Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites:

- Signals & Systems

Course Objectives

1. Introduce the concepts of Digital Signal Processing and its applications
2. Understand Discrete Fourier Transforms and its properties
3. Use Z-Transform for Realization of Digital Filters
4. Design and Implement Digital IIR and FIR Filters
5. Outline Sampling rate conversion in Multi-rate digital signal processing.

SYLLABUS

Unit-I **[10 Hrs]**

FREQUENCY ANALYSIS OF SIGNALS AND SYSTEMS: Introduction to DSP, Basic elements of Digital Signal Processing system, Advantages of Digital over Analog Signal Processing, Representation of Periodic Sequences: DFS, Representation of Aperiodic Sequences: DTFT, Properties of DTFT, The Fourier Transform of Periodic Signals, Sampling the Fourier Transform.

Unit-II **[10 Hrs]**

DISCRETE FOURIER TRANSFORMS: Fourier Representation of Finite duration sequence: The DFT, Properties of the DFT, Linear convolution using DFT and Circular Convolution, Efficient computation of DFT: FFT Algorithms, Radix-2 decimation in time FFT Algorithm, Radix-2 Decimation in Frequency FFT Algorithm, Inverse FFT.

Unit-III **[10 Hrs]**

Z-TRANSFOMS : The Z-Transform, Properties of the Region of Convergence for the Z-Transform.

Inverse Z-transform, Properties of Z-transforms, Analysis of LTI Systems in the z-Domain.

Unit-IV **[10Hrs]**

IIR FILTERS: Characteristics of commonly used Analog Filters. Frequency Transformations in the Analog Domain. Design of IIR Digital filters from analog filters: IIR Filter Design by Impulse Invariance, IIR filter Design by the Bilinear Transformation, Direct-Form Structures, Cascade Form Structures, Parallel-Form Structures of IIR Filters.

Unit-V **[10Hrs]**

FIR FILTERS: General Conditions, Design of FIR Filters - Symmetric & Anti-symmetric FIR filters, Design of Linear-phase FIR filters using Fourier Series Method and Windows, Design of Linear Phase FIR filters by the Frequency-Sampling Method, and Comparison of IIR & FIR filters. Direct Form Structures, Cascade Form Structures of FIR Filters

Course Outcomes: By the end of the course the student will be able to:

Cos	Description	Bloom's Level
CO 1	Distinguish between DFS and DTFT	II-Understanding
CO 2	Apply the Discrete Fourier Transforms to convert the signal from time domain to frequency domain and vice-versa using IDFT.	III-Applying
CO 3	Make use of Fast Fourier Transform for reducing the computational complexity of DFT	III-Applying
CO 4	Apply Z-transforms and its properties on different discrete time signals and systems.	III- Applying
CO 5	Design and Implement Digital IIR and FIR Filters.	VI-Creating

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	3	3		3										
CO 2	3		3	3										
CO 3	3		3	3										
CO 4	3		3	3										
CO 5	3		3	3										

Text Books

T1. A.V. Oppenheim and R.W. Schafer, "Discrete Time Signal Processing", 3rd Ed. PHl, 1989.

T2. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithmsand Applications", Prentice Hall, 1997.

Reference Books

R1. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", PHl, 1992

R2. Digital Signal Processing Using MATLAB, 3rd ed. Vinay K. Ingle John G. Proakis

EMPLOYABILITY SKILLS

(English, Aptitude and Logical Reasoning)

(Common to All Branches**)**

Subject Code: UGBS5T0122	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**2**	**3**

PREREQUISITE : Basic competency in understanding passages and the use of grammar & words correctly

COURSE OBJECTIVES:

- To expose students to enhance their verbal ability and interpersonal skills
- To prepare students to acquire skills in aptitude for careers prospects
- To prepare students to develop logical reasoning for employment

SYLLABUS

UNIT I [**9 Hrs]**

High frequency words: Selected 101 words with their ***basic*** meaning, commonly used synonyms and 101 words usage in sentences

UNIT II **[9 Hrs]**

Reading Comprehension passages: Tactics in understanding the given Comprehension passages & Practice tests

UNIT III **[9 Hrs]**

Interpersonal Skills: Verbal & Non-verbal Communication & Team Work

Percentages -Percentage-Conversion of fraction to percentage and Percentageto Fraction-percentage excess & shortness, Effect of percentage change on a Number-Effect of two step change-Effect of percentage change on product.

UNIT IV **[9 Hrs]**

Time & Work: Rate of work -Work as a single unit -No. of persons working together – No. of man days.

Time & Distance: Speed - Average Speed - problems on trains – Relative speed - Boats and streams

UNIT V **[9 Hrs]**

Coding, Decoding, Letter and Number Series: Letter Coding, Direct Letter coding, Number / Symbol coding, Substitution Coding, Deciphering message word coding and its types, Number series, Letter Series.

Data Analysis and Interpretation: Tabulation- Pie Charts – Bar Diagrams – Line Graphs.

COURSE OUTCOMES: Upon the completion of the course, students will be able to:

CO1: Make effective use of words in receptive as well as productive communication (L3)

CO2: Examine the Reading comprehension passages to understand and later, answer thequestions correctly (L2)

CO3: Develop team work and interpersonal skills with groups as well as the skill of calculating percentages (L3)

CO4: Apply the knowledge of math in distance, time related concepts (L3)

CO5: Develop proficiency in numerical reasoning. (L3)

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	-	-	-	-	-	-	-	-	3	-	3
CO2	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	3

Text Books:

1. Objective English – Hari Mohan Prasad & Uma Rani
2. Professional Communication – Globarena – IEG publications
3. A Modern Approach to Verbal and Non-verbal Reasoning by Dr.R.S.Aggarwal
4. Quantitative aptitude and Reasoning by R V Praveen (3rd edition)

Reference:

1. High frequency 101 word list: https://crunchprep.com/gre/101-high-frequency-gre-words
2. Quantitative Aptitude by Abhijit Guha – TMH Publishers

INFORMATION THEORY AND CODING

(Professional Elective-I)

Subject Code: UGEC5T0422	**L**	**T**	**P**	**C**
III Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Digital Communication

Course Objectives: The objectives of this course are

- To introduce about the fundamental concepts of Information Theory
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.
- To know about channel capacity and source coding techniques.

SYLLABUS

UNIT I **[8 Hrs]**

INFORMATION THEORY: Introduction, Types of Information sources, Discrete messages, Concept of amount of information and its properties, Average information, Entropy and its properties, Information rate, Mutual information and its properties, Classification of Channels-Binary symmetric Channel, Binary Erasure Channel, Channel Matrices for different Channels.

UNIT II **[8 Hrs]**

CHANNEL CAPACITY & SOURCE CODING: Shannon-Hartley Theorem, Channel capacity of analog and discrete Channels, Capacity of a Gaussian channels, bandwidth –S/N trade off, Introduction to source coding, Shannon's source coding theorem, Shanon-Fano coding, Huffman coding, Coding efficiency calculations.

UNIT III **[8 Hrs]**

LINEAR BLOCK CODES: Introduction to channel coding, Systematic and Non-systematic codes, Matrix description of Linear Block codes, Encoding using Generator Matrix, Syndrome Calculation.

Decoding of linear block codes, Error detection and error correction capabilities of linear block codes.

UNIT IV **[8 Hrs]**

BINARY CYCLIC CODES: Introduction**,** Polynomial Representation of Code words, Generator Polynomial, Systematic cyclic codes, Encoder design, Syndrome Calculation, Error Detection, Decoder design, and Limitations of Cyclic Codes.

UNIT V **[8 Hrs]**

CONVOLUTIONAL CODES: Introduction, Encoder Design, Encoding-Time Domain, Graphical approach: Code Tree, State and Trellis diagrams, Decoding of Convolution Codes-Viterbi algorithm, Sequential Decoding, Advantages and Limitations of Convolution codes, Comparison of Block codes and convolution codes.

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

COs	Description	Bloom's Level
CO 1	Relate information, entropy and mutual information's of a discrete memory less source	II-Understanding
CO 2	Apply various source coding techniques for data compression	III- Applying
CO 3	Analyze the error controlling performance of block codes.	IV- Analyzing
CO 4	Compare different encoding and decoding techniques of convolution codes.	IV- Analyzing

CO-PO MAPPING:

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	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS

T1. John G Proakis, "Digital Communications", McGraw-Hill, 4th Edition, 2000.

T2. K. Sam Shanmugham, "Digital and Analog Communication Systems", wiley student Edition, John wiley and sons, 2006.

REFERENCES

R1. Sanjay Sharma, "Digital communication systems", seventh edition, S.K.Kataria & sons 2016.

R2. K. Deergha Rao, Channel coding Techniques for wireless communications, 2nd edition, Springer, 2019.

MACHINE LEARNING

(Professional Elective -I)

Subject Code: UGEC5T0522	**L**	**T**	**P**	**C**
III Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites

The student should have prior knowledge on

- Mathematics -II

Course Objectives:

The objectives of this course is

- to provide exposure on the advances in the field of Machine learning
- to apply for real world problems.

SYLLABUS

UNIT I **[10 Hrs]**

FOUNDATIONS OF LEARNING: Components of learning –learning models: geometric models –probabilistic models –logic models –grouping and grading – learning versus design –types of learning: supervised–unsupervised –reinforcement – theory of learning: feasibility of learning –error and noise –training versus testing – theory of generalization: generalization bound –approximation-generalization tradeoff –bias and variance –learning curve

UNIT II **[10 Hrs]**

LINEAR MODELS: Linear classification – univariate linear regression –multivariate linear regression – regularized regression – Logistic regression – support vector machines – soft margin SVM – going beyond linearity –generalization and over fitting – regularization – validation

UNIT III **[10 Hrs]**

DISTANCE-BASED MODELS: Nearest neighbor models –K-means –clustering around medoids

Silhouttes –hierarchical clustering –k-d trees –non-parametric regression

UNIT IV **[10 Hrs]**

TREE AND RULE MODELS: Decision trees, Impurity functions –learning decision trees: ID3 algorithm –regression trees: CART Algorithm – Rule based Models: learning ordered rule lists –learning unordered rule lists

UNIT V **[10 Hrs]**

Artificial Neural Networks: Introduction to Artificial Neural Networks: perceptron – single layer and multi-layer - back propagation, Introduction to Deep Learning, Ensemble learning, bagging, boosting, stacking, random forests

Course Outcomes

Upon Completion of the course, the students will be able to

COs	Description	Blooms Level
CO 1	Demonstrate the machine learning theory	II-Understanding
CO 2	Construct linear and non-linear learning models	III-Applying
CO 3	Construct distance-based clustering techniques	III-Applying
CO 4	Categorize rule-based models	IV-Analyzing
CO 5	Apply machine learning algorithms to solve problems of moderate complexity	III-Applying

Mapping of COs to POs

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3													
CO 2		3												
CO 3			3											
CO 4			3										3	
CO 5											3	3	3	

Text Books

T1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, "Learning from Data", AML Book Publishers, 2012.

T2. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.

Reference Books

R1. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.

R2. D. Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012.

ELECTRONIC INSTRUMENTATION

(Professional Elective-I)

Subject Code: UGEC5T0622	**L**	**T**	**P**	**C**
III Year /I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Circuit Analysis
- Fundamentals of Analog Electronics
- Signals and Systems

Course Objectives

1. To outline different electronic instruments used for measurement of various electrical parameters
2. To list various bridges used for measuring the various measurements
3. To demonstrate the process of data acquisition

SYLLABUS

UNIT I **[10 Hrs]**

QUALITIES OF MEASUREMENTS: Performance Characteristics, Static Characteristics-Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Types of Static Error, Sources of Error, Dynamic Characteristics-Speed of response, Fidelity, Lag and Dynamic error.

AMMETERS: DC Ammeters, Multirange Ammeters, Aryton Shunt, Requirements of a shunt, Extending of Ammeter Ranges.

VOLTMETERS & MULTIMETERS : Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Ohmmeters - Series type, Shunt type.

UNIT II **[12 Hrs]**

SIGNAL GENERATORS: Fixed frequency AF oscillator, Variable AF Oscillators, Standard Signal Generator, AF Sine wave and Square Wave Generator, Function Generator, Square and Pulse Generator (Laboratory Type), Random Noise Generator.

WAVE ANALYZERS & HARMONIC DISTORTION: Basic Wave Analyzer, Frequency Selective Wave Analyzer, Heterodyne Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer.

UNIT III **[10 Hrs]**

BRIDGES: Wheatstone's Bridge (Measurement of resistance), Kelvin's Bridge, AC Bridges, Capacitance Comparison Bridge, Inductance Comparison, Maxwell's bridge.

Schering Bridge, Wien's Bridge, Errors and precautions in using bridges, Q-meter.

UNIT IV **[11 Hrs]**

OSCILLOSCOPES: CRT features, Block diagram of Oscilloscope, Vertical Amplifier, Horizontal Deflecting System, Dual Beam CRO, Dual Trace oscilloscope, (VHF) Sampling Oscilloscope, Storage Oscilloscope (VLF), Digital Storage Oscilloscope, Use of Lissajous Figures for Phase Measurement.

UNIT V **[9 Hrs]**

DATA ACQUISITION SYSTEMS: Objectives of DAS, Signal Conditioning of Inputs, Single Channel DAS, D/A to A/D Converters, Data loggers.

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

COs	**Description**	**Bloom's Level**
CO 1	Outline the performance characteristics of instruments	II-Understanding
CO 2	Explain various signal generators	II-Understanding
CO 3	Compare different types of Wave Analyzers	IV- Analyzing
CO 4	Categorize different types of bridges used in measurement	IV-Analyzing
CO 5	Illustrate the features of Oscilloscopes	II-Understanding
CO 6	Identify the components of Data Acquisition Systems	III-Applying

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	3		3											
CO 2	3		2											
CO 3	3		2											
CO 4	3		3											
CO 5	3	3	3											
CO 6	3		3											

Text Books:

T1. H. S. Kalsi, "Electronic Instrumentation", TMH, 2nd Edition

T2. A.D. Helfrick and W.D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 5th Edition, 2002

Reference Books:

R1. A.K.Sawhney, "A course in Electrical and Electronic Measurements and Instrumentation" Dhanpat Rai Publications.

R2. K. LalKishore, "Electronic Measurements and Instrumentation", Pearson Education-2005.

SCRIPTING LANGUAGES

(Professional Elective-I)

Subject Code: UGEC5T0722	**L**	**T**	**P**	**C**
III Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites:

- Unix
- Any programming language(C/C++)

Course Objectives: The objectives of this course is

- To master theory behind scripting and its relation to classic programming
- To design and implement one's own scripting language.

SYLLABUS

UNIT I

Introduction to Linux: File System of the Linux, General usage of Linux kernel & Basic commands, Linux users and group, Permissions for file, directory and users, Searching a file & directory, zipping and unzipping concepts.

UNIT II

Linux Networking : Introduction to Networking in Linux, Network basics & tools, File transfer protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services

UNIT III

Introduction to Scripts and Scripting Characteristics and uses of scripting languages : Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures.

Built-in functions, Collections of Data, Working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments

UNIT IV

TCL : The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/ output, Procedures Working with Strings, Patterns, Files and Pipes, Example code.

UNIT V

Tk: Visual toolkits, Fundamental concepts of Tk, Tk by example, Events and bindings, Geometry managers, Tk Widgets-Buttons and Menus, Button Commands and Scope Issues, Menus and Menu buttons, Menu Accelerators

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

Cos	Description	Bloom's Level
CO 1	Demonstrate Linux environment	II-Understanding
CO 2	Explain network establishment in Linux	II-Understanding
CO 3	Illustrate the Characteristics and uses of scripting languages	II-Understanding
CO 4	Develop programs using PERL	VI-Creating
CO 5	Develop programs using TCL	VI-Creating
C0 6	Develop programs using Tk	VI-Creating

Mapping of Cos to Pos:

POs	1	2	3	4	5	6	7	8	9	10	11
CO 1					3						
CO 2					3						
CO 3					3						
CO 4			3		3	3			3		
CO 5			3		3	3			3		
C0 6			3		3	3			3		

TEXT BOOKS

T1. Red Hat Enterprise Linux 4: System Administration Guide Copyright 2005 Red Hat, Inc

T2. David Barron, "The World of Scripting Languages", Wiley Student Edition, 2010.

REFERENCE BOOKS

R1. Teach Yourself Perl 5 in 21 days by David Till.

R2. Tcl/Tk: A Developer's Guide- Clif Flynt, 2003, Morgan Kaufmann Series.

Verilog HDL Programming Lab

Subject Code: UGEC5P0822	**L**	**T**	**P**	**C**
III Year/ I Semester	**0**	**0**	**3**	**1.5**

Prerequisites:

- Digital Logic Design.

Laboratory Objectives:

The main objective of this lab course is to

- Gain practical hands-on experience by exposing the students to various digital Circuits.

Experiments (At Least 12 Experiments)

1. Study of Field Programmable Gate Array.
2. Realization and FPGA implementation of Logic gates using Verilog HDL.
3. Design and FPGA implementation of Adders and Subtractors using Verilog HDL.
4. Develop a Verilog model for a decoder and verify using CAD tool.
5. Develop a Verilog model for a priority encoder and verify using CAD tool.
6. Develop a Verilog model for a comparator and verify using CAD tool.
7. Develop a Verilog model for a multiplexer and verify using CAD tool.
8. Develop Verilog models for 4 – bit Gray to Binary and Binary to Gray Converter and verify using CAD tool.
9. Develop a Verilog model for a D/T flip flop using J-K flip flop and verify using CAD tool.
10. Develop a Verilog model for Shift Register and verify using CAD tool.
11. Develop a Verilog model for Universal Shift Register and verify using CAD tool.
12. Develop a Verilog model for synchronous counter and verify using CAD tool.
13. Develop a Verilog model for Decade counter and verify using CAD tool.
14. Develop a Verilog model for Moore Machine and verify using CAD tool.
15. Develop a Verilog model for Mealy Machine and verify using CAD tool.
16. Develop a Verilog model for Parallel Multiplier and verify using CAD tool.
17. Develop a Verilog model for Barrel Shifter and verify using CAD tool.
18. Develop a Verilog model for ALU and verify using CAD tool.

Laboratory Outcomes: Upon completion of the Lab, students will be able to

LOs	Description	Blooms Level
LO1	Demonstrate the use of Verilog HDL using Xilinx ISE.	II-Understanding
LO2	Design, simulate and synthesize combinational circuits using Verilog HDL.	VI- Creating
LO3	Design, simulate and synthesize sequential circuits using Verilog HDL.	VI- Creating
LO4	Make use of FPGA boards for the implementation of digital circuits.	III-Applying

Mapping of LOs to POs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
LO 1	3	3							3	3				
LO 2	3	3			3				3	3			3	
LO 3	3	3			3				3	3			3	
LO 4	3	3			3				3	3				3

Digital Signal Processing LAB

Subject Code: UGEC5P0922	**L**	**T**	**P**	**C**
III Year/ I Semester	**0**	**0**	**3**	**1.5**

Co-requisites

- Digital Signal Processing

Laboratory Objectives

- To verify various DSP algorithms using MATLAB Simulation Software.
- To implement the DSP algorithms on a DSP processor

Experiments (At least 12 Experiments)

1. Implementation of N-point DFT of a given sequence
2. Implementation of Linear convolution using DFT (Overlap-add and Overlap-Save methods)
3. Implementation of Circular convolution
4. Implementation of FFT for a given sequence and 1-D signal
5. Design and simulate the Analog filters and analyze their response
6. Design and simulate the IIR Butterworth and Chebyshev Filters and analyze their responses
7. Design and simulate the FIR Filters using windowing techniques and analyze their responses
8. Implementation of Decimation process for a given sequence and a signal
9. Implementation of Interpolation process for a given sequence and a signal
10. Implementation of I/D Sampling rate converters
11. Generate the time-frequency plot for a given voice/audio signal using STFT
12. Verify Band pass sampling theorem
13. Removing random noise from Audio/Voice signal
14. Study the architecture of TMS320C6713 DSP processor.
15. Perform Linear Convolution of two sequences using Code Composer Studio (CCS) and Implement the same on TMS320C6713 Processor
16. Perform Circular Convolution of two sequences using CCS and Implement the same on TMS320C6713 Processor
17. Implementation of FFT of a 1-D signal using CCS and Implement the same on TMS320C6713 Processor
18. Implementation of IIR Filter using CCS and Implement the same on TMS320C6713 Processor

Laboratory Outcomes

Upon completion of the Laboratory, students will be able to

LOs	**Description**	**Bloom's Level**
LO 1	Design and simulate Analog and Digital filters using MATLAB	VI-Creating
LO 2	Design and simulate Interpolator and Decimator using MATLAB	VI-Creating
LO 3	Make use of DSP algorithms on a DSP processor for real time applications.	III-Applying
LO 4	Apply various image processing techniques for a given image using MATLAB	III-Applying

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
LO 1	3				3				3	3				
LO 2	3		3		3				3	3				
LLO 3	3				3				3	3		3		
LO 4	3		3		3				3	3				

Data Structures Lab

Subject Code: UGEC5K1022	**L**	**T**	**P**	**C**
III Year/ I Semester	**1**	**0**	**2**	**2**

Pre-requisites

- Python Programming
- Python Programming Lab

Laboratory Objectives :

The course should enable the students to:

1) Understand various data representation techniques in the real world.
2) Implement linear and non-linear data structures.
3) Analyse various algorithms based on their time and space complexity.
4) Develop real-time applications using suitable data structure.
5) Identify suitable data structure to solve various computing problems.

Experiments (At least 10 Experiments)

1. Write a Python program for class, Flower, that has three instance variables of type str, int, and float that respectively represent the name of the flower, its number of petals, and its price. Your class must include a constructor method that initializes each variable to an appropriate value, and your class should include methods for setting the value of each type and retrieving the value of each type.
2. Develop an inheritance hierarchy based upon a Polygon class that has abstract methods area () and perimeter( ). Implement classes Triangle, Quadrilateral, Pentagon, that extend this base class, with the obvious meanings for the area() and perimeter( ) methods. Write a simple program that allows users to create polygons of the various types and input their geometric dimensions, and the program then outputs their area and perimeter.
3. Write a python program to implement Method Overloading and Method Overriding.
4. Write a Python program to illustrate the following comprehensions: a) List Comprehensions b) Dictionary Comprehensions c) Set Comprehensions d) Generator Comprehensions
5. Write a Python program to generate the combinations of n distinct objects taken from the elements of a given list. Example: Original list: [1, 2, 3, 4, 5, 6, 7, 8, 9] Combinations of 2 distinct objects: [1, 2] [1, 3] [1, 4] [1, 5] .... [7, 8] [7, 9] [8, 9].
6. Write a program for Linear Search and Binary search.
7. Write a program to implement Bubble Sort and Selection Sort.

8. Write a program to implement Merge sort and Quick sort.
9. Write a program to implement Stacks and Queues.
10. Write a program to implement Singly Linked List.
11. Write a program to implement Doubly Linked list.
12. Write a program to implement Binary Search Tree.

Laboratory Outcomes : The student will have the ability to:
LO 1: Understand the concept of data structures, python and apply algorithm for solving problems like Sorting, searching, insertion and deletion of data.
LO 2: Understand linear data structures for processing of ordered or unordered data.
LO 3: Explore various operations on dynamic data structures like single linked list, circular linked list, and doubly linked list.
LO 4: Explore the concept of nonlinear data structures such as trees and graphs.
LO 5: Understand the binary search trees, hash function, and concepts of collision and its resolution methods.

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
LO 1	3				3				3	3				
LO 2	3		3		3				3	3				
LO 3	3				3				3	3		3		
LO 4	3		3		3				3	3				

INTELLECTUAL PROPERTY RIGHTS & PATENTS
(Common to all branches)

Subject Code: UGMB5A0122	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**0**	**0**

Course Objectives: This course introduces about intellectual property laws, trademarks, copyrights and patents.

Syllabus:

UNIT-I **[6 Hrs]**

Intellectual Property Law: Basics, Types, Agencies Responsible for IP Registration, International Organizations, Agencies and Treaties, Importance of IPR.

Trademark Law: Purpose of Trademarks, Types, Acquisition, Common Law Rights, Laws and Treaties Governing Trademarks, Categories, Trade Names and Business Names, Protectable Matter, Exclusions from Trademark Protection, Selecting and Evaluating a Mark, Trademark Search.

UNIT-II **[5 Hrs]**

Copyright Law: Common Law Rights, Originality of Material, Fixation of Material, Works of Authorship, Exclusions, Compilations, Collections and Derivative Works.

Rights Afforded by Copyright Law: Rights of Reproduction, Derivative Works, Distribution and the First Sale Doctrine, Work Publicly, Rights to Display the Work Publicly, Other Limitations on Exclusive Rights, Moral Rights and the Visual Artists Rights, Compulsory Licenses.

UNIT-III **[7 Hrs]**

Copyright Ownership and Transfers: Ownership Issues, Joint Works, Ownership in Derivative or Collective Works, Works Made for Hire, Transfers, Termination of Transfers and Duration.

Copyright Infringement: Elements, Contributory and Vicarious Infringement, Defences to Infringement, Infringement Actions.

New Developments: Protection for Computer Programs and Automated Databases, Copyright in the Electronic Age, Entertainment Notes, Recent Developments, Terms of the Trade, Semiconductor Chip Protection.

UNIT-IV **[6 Hrs]**

Patent Law: Introduction, Patentability, Design Patents, Plant Patents, Double Patenting.

Patent Searches and Application: Searching, Application Process, Prosecuting the Application, Post-issuance Actions, Term and Maintenance of Patents.

Patent Ownership and Transfer: Ownership Rights, Sole and Joint Inventors, Disputes, Inventions made by Employees and Independent Contractors, Assignment of Rights, Licensing, Invention Developers and Promoters.

UNIT-V **[6 Hrs]**

Patent Infringement: Direct Infringement, Inducement to Infringe, Contributory Infringement, First Sale Doctrine, Indirect Infringement, Infringement Abroad, Claims Interpretation, Defences, Remedies, Resolving a Dispute and Litigation.

New Developments: International Patent Protection, Patent Cooperation Treaty, European Patent Organization, Patent Prosecution Highway, Agreement on Trade-Related Aspects of IPR, Patent Law Treaty, Foreign Filing Licenses.
Intellectual Property Audits: Practical Aspects of Intellectual Property Audits, Conducting the Audit, Postaudit Activity.

Course Outcomes:
Upon completion of this course, the students will be able to:
CO1: Understand the intellectual property law.
CO2: Understand the need of trademark and its use.
CO3: Familiar with copyright laws and its rights, ownership, transfers and copyright Infringement.
CO4: Acquire the knowledge on various aspects of patents.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	-	-
CO3	3	3	3	-	-	-	-	3	-	3	-	-
CO4	3	3	3	-	-	3	3	3	-	3	-	-

TEXT BOOKS:
1. Deborah E. Bouchoux, "Intellectual Property", Cengage Learning
2. Asha Vijay, Durafe Dhanashree and K. Toradmalle, "Intellectual Property Rights", Wiley India
3. Neeraj Pandey and Khushdeep Dharni, "Intellectual Property Rights", PHI Learning, 2014.

REFERENCE BOOKS:
1. Kompal Bansal & Parishit Bansal, "Fundamentals of IPR for Engineers", BS Publications.
2. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw Hill, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian, "Intellectual Property Rights", Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali, "Intellectual Property Right", Serials Pub.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
6. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand.
8. Dr. A. Srinivas, "Intellectual Property Rights (Patents & Cyber Law)", Oxford University Press, New Delhi.

III YEAR
II SEMESTER

ELECTROMAGNETIC WAVES

Subject Code: UGEC6T0122	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Students should have prior knowledge of

- Engineering Electromagnetics

Course Objective: To provide an understanding of

- To understand and develop various applications involving electromagnetic fields
- Basic terminology and concepts of Antennas in the antenna design process
- The analysis from electric and magnetic field emission, knowledge on antenna operation and types as well as their usage in real time field

SYLLABUS

Unit –I **[12 Hrs]**

Radiation Mechanism : Introduction to antenna and its significance, conceptual view of radiation mechanism, methods to solve radiation problems, vector magentic potential, Alternating Current element, induction field, radiation field, power radiated by current element, definitions of beamwidth, radiation resistance, beam solid angle, gain, directivity and effective area.

Unit –II **[10 Hrs]**

Wire Antennas : Radiation of half wave dipole, power radiated and radiation resistance of half wave dipole and quarter wave monopoles, Folded Dipole, radiation resistance of folded dipole, loop antennas –general Case, Small Loop-Radiation resistance, Directivity, antenna reactance.

Unit – III **[12 Hrs]**

Theorems and Arrays : Antenna Theorems, Antenna arrays- Sidelobel level, beamwidths of Broadside and end fire arrays, principle of pattern multiplication and its applications, binomial array.

Practical Antennas : Travelling wave radiators – Inverted Vee and rhombic antennas, parasitic array, parabolic reflector, horn antenna, helical antennas. Microstrip antennas.

Unit IV **[8 Hrs]**

Antenna Measurements : Measurement of Radiation Pattern, VTM Cell, Anechoic chamber, far field criterion, generic electrical parameters of interest –, beamwidth, gain, impedance, polarization and phase.

Unit V **[10 Hrs]**

Propagation : Propagation mechanisms – ground wave, sky wave and space wave. Ground Wave Propagation-wave tilt in ground wave propagation.Troposcatter propagation, Skywave Propagation- Virtual height, Critical frequency, maximum usable frequency, secant law, skip distance. Space wave propagation - LOS distance, modified earth radius, phase difference between direct and ground reflected rays.

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

COs	Description	Bloom's Level
CO 1	Make use of mathematical expressions to observe the radiation Phenomena of wire antennas.	III-Applying
CO 2	Analyze antenna array concepts	IV- Analyzing
CO 3	Outline the concepts of various antennas from HF to SHF applications	II-Understanding
CO 4	Summarize measurement procedures for antenna parameters.	III-Applying
CO 5	Interpret the effect of nature on EM wave in different propagation modes.	II-Understanding

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1	3	3	2										3	
CO 2	3	3	3	2									3	
CO 3	3												3	
CO 4	3	3	3										2	
CO 5	3	3											3	

Text Books

T1. E C Jordon and K G Balmain, "Electromagnetic Waves & Radiating Systems", PHI 2nd Edition

T2. G S N Raju, "Antennas & wave Propagation", Pearson Education Ltd., 2005

Reference Books

R1. J D Kraus and R J Marhefka, " Antennas for all applications", TMH, 3rd Edition

R2. C A Balanis, "Antenna Theory –, John wiley& sons, 2nd Edition, 2005

R3. E.V.D. Glazier and H.R.L. Lamont "Transmission and Propagation" Her Majesty's Stationary Office, UK 1958

VLSI DESIGN

Subject Code : UGEC6T0222 **L T P C**

III Year/ II Semester **3 0 0 3**

Prerequisites

- Analog Electronic Circuits
- Digital logic Design

Course Objectives

1. To provide an overview of the principles, operation and application of the analog building block MOSFET for performing various functions.
2. To Introduce the technology, design concepts,electrical properties and modeling of Very Large Scale Integrated circuits.
3. To understand the basics of MOS Circuit Design and modeling and the basics of Semiconductor Integrated Circuit Design.

SYLLABUS

UNIT-I **[8 Hrs]**

INTRODUCTION TO MOS TECHNOLOGY: Evolution of VLSI, Moore's Law, Basic MOS transistors, enhancement and depletion modes of transistor action, MOS and related VLSI technology, NMOS, CMOS, BICMOS, IC production process, Comparison between CMOS and Bipolar technologies.

UNIT-II **[12 Hrs]**

BASIC ELECTRICAL PROPERTIES OF MOS AND BICMOS CIRCUITS : I_{DS} versus V_{DS} Relationship, aspects of MOS transistor threshold voltage, MOS trans conductance and output conductance, MOS transistor figure of merit, pass transistor, MOS inverter ,determination of pull–up to pull- down ratio for nMOS inverter driven by another nMOS inverter and for an nMOS inverter driven through one or more pass transistors, alternative forms of pull –up, the CMOS inverter, MOS transistor circuit model, Bi-CMOS inverter, latch –up in CMOS circuits and Bi-CMOS latch up susceptibility.

UNIT-III **[14 Hrs]**

MOS and Bi-CMOS Circuit Design Processes: VLSI design flow, MOS layers, stick diagrams, design rules and Layout- wires and vias, Lambda based design rules,2μ meter, 1.2μ meter design rules, double metal double poly CMOS rules, Layout diagrams of Universal gates.

Scaling of MOS Circuits: Scaling models, Scaling factors for device parameters, Limitations of Scaling**,** Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise, Limits due to current density.

UNIT-IV [8 Hrs]

BASIC CIRCUIT CONCEPTS: Sheet Resistance, Sheet Resistance concepts applied to MOS transistors and inverters, Area capacitance of layers, standard unit of capacitance some area capacitance calculations, delay unit, inverter delays, driving large capacitive loads, wiring capacitances, choice of layers. Introduction to switch logic, gate logic, other forms of CMOS logic-Domino logic, Pseudo logic, Transmission Gate.

UNIT-V [8 Hrs]

SUBSYSTEM DESIGN: Subsystem Design: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters. Implementation approaches in VLSI: full custom design, semi-custom design, gate arrays, standard cells.

Course Outcomes :

Upon completion of the course, students will be able to

CO'S	**Description Blooms Level**	**Blooms Level**
C01	Demonstrate the fabrication steps of various MOS technologies.	III-Applying
C02	Evaluate electrical properties of MOS transistors.	III-Applying
C03	Construct layouts using MOS technology-specific layout and Analyze scaling rules.	III-Applying
C04	Illustrate the basic circuit concepts and the design prospects of various subsystems	IV-Analyzing

Mapping of COs to POs

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
CO2	3	3											3	3
CO3	3	3												
CO4			3						2			2		3

Text Books

T1. Kamran Eshraghian, Douglas A.Pucknell, SholehEshraghian, "Essential of VLSI Circuits and systems" PHI, 2005.

T2. Modern VLSI Design, Wayne Wolf, PHI, Fourth Edition,2007.

Reference Books

R1. Introduction to VLSI Circuits and systems, John P. Uyemura,JhonWiely, 2005 Edition.

R2. Neil H.Weste, "Principles of CMOS VLSI Design", John Wiely, 2006 Edition.

EMBEDDED SYSTEMS DESIGN WITH ARM

Subject Code: UGEC6T0322	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites

- Digital Logic Design
- IoT Lab

Course Objectives

- To Introduce the concepts of Embedded Systems related to Chip Development.
- To Understand Technical Overview of Arm Cortex-M Processor & AMBA.
- To familiarize Design of an Embedded System using Arm Cortex-M Processor by Interfacing different Peripheral Devices.

SYLLABUS

UNIT-I

8051Microcontroller: Introduction to Microcontrollers, comparing Microprocessors and Microcontrollers, choosing a microcontroller, Architecture of 8051 Micro controller, Register organization of 8051, SFRs, Pin configuration of 8051, Interrupts and Timers

Unit-II

The Arm Cortex-M Processor Architecture: Processor Architecture, Cortex-M Processor Families, Arm Cortex-M Programmers Model, Memory Model, Exceptions and Interrupts.

Unit-III

The Advanced Microcontroller Bus Architecture (AMBA) : Overview, History of AMBA, AHB-Lite and APB Interconnect Protocols

AHB-Lite Interconnect Protocol, AXI Interconnect Protocol.

Unit-IV

Interfacing with the External World : External Bus Architectures,
Serial Interfacing Techniques: ISO-OSI Model, Bit Coding, UARTs, RS-232, SPI, I2C, CAN,USB,
Networks: Ethernet, Bluetooth, Wi-Fi, Zigbee.

Unit-V

Peripherals : Role of Peripherals, GPIOs, AHP UART, AHB SPI, AHB Timer, AHB I2C, Analog Peripherals: ADC and DAC.

Course Outcomes: By the end of the course, the student will be able to

COs	Description	Blooms Level
CO1	Acquire knowledge of the architecture and operation of Intel 8051 microcontroller	II - Understanding
CO2	Analyze Arm Cortex-M Processor & AMBA Architecture in view of Designer and Programmer	IV -Analyzing
CO3	Inspect different bus Architectures and Interfacing methods of Arm Processor	IV -Analyzing
CO4	Build an Embedded System using ARM Cortex Processor by interfacing different peripheral devices	VI- Creating

Mapping of COs to POs:

CO\ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3		3									2		
CO2	1	3	3		3							3	3	3
CO3		3	3									3		
CO4		3			3	2						3		

Text Books

T1. Muhammed Ali Mazidi, Janice GillispieMazidi, Rolin D McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 2nd Edition, Pearson Education, 2008.

T2. René Beuchat, Florian Depraz, "Fundamentals of System-on-Chip Design on Arm Cortex-M Microcontrollers" by Arm Education Media

T3. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors" by Elsevier , ARM Ltd., Cambridge, UK, 2014.

References

R1. Embedded systems Architecture by Tammy Noergaard, Elsevier Publications, 2005.

R2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014.

MODERN WIRELESS COMMUNICATIONS

(PROFESSIONAL ELECTIVE –II)

Subject Code: UGEC6T0422	**L**	**T**	**P**	**C**
III Year/ II Semester	**3**	**0**	**0**	**3**

Prerequisites

- Communication Theory
- Digital Communication

Course Objectives: In this course it is aimed to introduce to the students about

- New trends in mobile/wireless communication, 3G/4G standards to help students understand practical aspects
- Understanding of communication network analysis along with its real-world applications
- Description of radio propagation over wireless channel and its limitations

SYLLABUS

Unit I **[8 Hrs]**

Wireless Generation Technologies: First- and Second-Generation Technologies, TDMA-based 2G standards, IS-95, 2.5G, Third Generation development, 3G Air Interface Technologies, 3G Spectrum, Internet speeds of 2G, 2.5G and 3G Technologies, Limitations of 3G, Quality of Service in 3G. 4G Wireless Standards and features of 5G Technologies.

UNIT II **[10 Hrs]**

Principles of Wireless Communication: The Wireless Communication Environment, Modeling of Wireless Systems, System Model for Narrowband Signals, Rayleigh Fading Wireless Channels, BER Performance of Wireless Systems, Intuition for BER in a Fading Channel, Channel Estimation in Wireless Systems, Diversity in Wireless Communications.

Unit III **[12 Hrs]**

The Wireless Channel: Basics of Wireless Channel Modelling, Average Delay Spread in Outdoor Cellular Channels, Coherence Bandwidth in Wireless Communications.

Relation Between ISI and Coherence Bandwidth, Doppler Fading in Wireless Systems, Doppler Impact on a Wireless Channel, Coherence Time of the Wireless Channel.

Unit IV **[10 Hrs]**

Multiple-Input Multiple-Output Wireless Communications (MIMO): MIMO System Model, MIMO Zero-Forcing (ZF) Receiver, MIMO MMSE Receiver, Singular

Value Decomposition (SVD) of the MIMO Channel, Singular Value Decomposition and MIMO Capacity.

Unit V **[10 Hrs]**

Orthogonal Frequency-Division Multiplexing: Introduction, Motivation and Multicarrier Basics, OFDM Example, Bit-Error Rate (BER) for OFDM, MIMO-OFDM, Effect of Frequency Offset in OFDM, OFDM – Peak-to-Average Power Ratio (PAPR), SC-FDMA.

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

COs	Description	Bloom's Level
CO 1	Outline the Wireless Generation Technologies ranging from 1G to 5G	II - Understanding
CO 2	Identify the performance of wireless systems and Channels	III - Applying
CO 3	Examine the Operation of MIMO System	IV - Analyzing
CO 4	Make use of the concepts of OFDM	IV - Analyzing

Mapping of COs to POs:

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			-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	3	-	-	-	-	-	-	-	-	-	-

Text Books:

T1. Aditya K Jagannadham, "Principles of Modern Wireless communications", McGraw Hill, 2016.

T2. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson Education 2013..

Reference Book:

R1. Theodore S Rappaport, "Wireless Communication Principles and Practice", 2nd Ed, Pearson Education. 2002.

R2. C Y Lee, "Cellular and Mobile Communications", McGraw Hill, 2nd Edition,2006

DIGITAL IMAGE PROCESSING

(Professional Elective -II)

Subject Code: UGEC6T0522	**L**	**T**	**P**	**C**
III Year/ II Semester	**3**	**0**	**0**	**3**

Prerequisites

- Digital Signal Processing

Course Objectives

1. To list and explain different types of image processing techniques
2. To apply image processing for different real time applications

SYLLABUS

Unit I: INTRODUCTION [10 Hrs]

Introduction to Digital Image Processing, Fundamental steps in image processing systems, Components of Image Processing System, Elements of Visual Perception, a simple Image Model, Sampling and quantization, Basic relationship between pixels, Mathematical tools used in image processing, need for image transform and The Discrete Fourier Transform, Properties of 2-D Fourier Transform, DCT, Walsh, Slant, Hoteling Transform

UNIT II: IMAGE ENHANCEMENT [12 Hrs]

Some basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering –smoothing spatial filters and sharpening spatial filters, combining spatial enhancement methods, Image smoothing using frequency domain filters Selective filtering and implementation

UNIT-III: IMAGE RESTORATION & RE-CONSTRUCTION [08 Hrs]

A Model of the Image degradation/restoration process, Noise models, Restoration in the presence of noise only-spatial filtering

linear Position invariant degradation, Estimating the degradation function and inverse filtering, Wiener filtering, Constrain least square filtering.

UNIT IV: IMAGE COMPRESSION [10 Hrs]

Fundamentals: Coding Redundancy, Spatial and Temporal Redundancy, some basic Compression methods: Huffman Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Variable length coding, Dictionary-based coding, Image Compression standards, JPEG, JPEG 2000.

UNIT V: SEGMENTATION [10 Hrs]

Point, line and edge detection, Thresholding, Region oriented segmentation, Segmentation using morphological watersheds, Use of motion in segmentation.

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

COs	Description	Bloom's Level
CO 1	Outline the fundamental steps of image processing	II-Understanding
CO 2	Apply 2-D transformation techniques on images and explain their significance	III-Applying
CO 3	Analyze image enhancement techniques in image processing	IV-Analyzing
CO 4	Explain the degradation and restoration model of an image	II-Understanding
CO 5	Explain various image compression techniques.	II-Understanding
CO 6	Discuss different image segmentation techniques	III-Applying

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	3													
CO 2	3	2	3	2										
CO 3	3		3	2										
CO 4	3	3	3	2										
CO 5	3	2	3	3										
CO 6	3	2	3	2										

Text Books

T1. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing" Pearson Education, 2011.

T2. S. Sridhar, "Digital Image Processing". 2nd Ed. Oxford University Press.

Reference Books

R1. S. Jayaraman, S, Esakkirajan, T. Veerakumar, "Digital Image Processing" McGraw Hill Publisher,2009

R2. B. Canda and D Dutta Mjumder" Digital Image Processing and analysis" Prentice Hall of india, 2011/12(print)

SENSORS AND APPLICATIONS

(Professional Elective-II)

Subject Code: UGEC6T0622	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites

- Control Systems
- Electronic Instrumentation

COURSE OBJECTIVES: This course introduces the students about the sensors and their characteristics. It also allows the students to understand the working principles of various sensors, so they develop judgment of what sensors and modalities are appropriate for different applications.

SYLLABUS

Unit-I

Mechanical Transducers : Introduction to sensors – classification – static and dynamic characteristics, Temperature measurement-Absolute thermodynamic, Bimetallic element, Pressure measurement-Manometers (Ring-balance & bell-type), Membranes, Force Measurement-Helical spiral springs, Cantilever beams, Diaphragm elements, Torque Measurement-Torsion bar, Flat spiral spring, Flow measurement-Static Vane elements, Rotating Vane elements, Rotameter float systems.

Unit-II

Passive Electrical Transducers : Introduction, Resistive Transducers-Resistance Thermometer, Resistive strain transducer, Inductive Transducers-Inductive Thickness Transducer, Inductive Displacement Transducer, Movable Core-type inductive transducer, Capacitive Transducers- Capacitive Displacement transducer.

Unit-III

Active Electrical Transducers : Introduction, Thermoelectric Transducers-Thermocouple, Piezoelectric Transducers-Piezoelectric force & strain transducers, Magnetostrictive force transducers, Hall-effect transducer.

Electromechanical Transducers-Tachometers, Electromagnetic flowmeter, Digital Transducers-Digital Displacement Transducers, Digital Tachometers, Transducer oscillators.

Unit-IV

Feedback Transducer Systems : Introduction, Feedback fundamentals, Inverse Transducers, Temperature balance systems, Self-biasing potentiometers, Heat-Flow

balance systems, Beam balance system, Servo-operated manometers, Feedback pneumatic load cell, Feedback Accelerator system, Integrating servo.

Unit V

Data Display & Recording Systems : Introduction, Data loggers, Analog Indicators, Digital Readout Systems-Alphanumeric devices, CRT Readout systems, Magnetic Tape Recorders-Direct Recording, Frequency modulation recording, Digital Recording technique, Floppy disc, Digital I/O devices.

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

CO 1 Classify sensors based on their properties and define the characteristics of the sensors.

CO 2 Examine how the stimuli is converted into electrical energy by using the physical principles of sensing such as piezo electric effect, Hall Effect, heat transfer and light.

CO 3 Describe the construction of the motion and displacement sensors and their applications.

CO 4 Explain the construction of the Display & Recording Systems of various devices.

Mapping of COs to PO

CO\ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3										2	2		
CO2		3									2	3		
CO3			3								2	2		
CO4			3								2	2		

Text Books:

T1. "Transducers &Instrumentation" by D V S Murthy, 2nd Edition, PHI.

T2. D. Patranabis, "Sensors and Transducers", second edition, 2005, PHI Publications.

Reference Books:

R1. Jacob Fraden, "**Handbook of Modern Sensors – physics, designs and applications**", fourth edition, 2010, Springer edition.

R2. Ian Sinclair, "**Sensors and Transducers**", third edition, Elsevier India.

ANALOG IC DESIGN

(PROFESSIONAL ELECTIVE –II)

Subject Code : UGEC6T0722	**L**	**T**	**P**	**C**
III Year/ II Semester	**3**	**0**	**0**	**3**

Prerequisites

The student should have prior knowledge on

- Circuit Analysis
- Fundamentals of Analog Electronics
- Analog Electronic Circuits
- Analog IC Applications

Course Objectives: The objectives of this course is

- To introduce the basics of MOSFET, its characteristics, second order effects, small signal model of MOSFET.
- To analyze the small signal analysis and large signal analysis for single stage amplifiers, differential amplifiers, current sources, current mirrors and frequency response of amplifiers.

SYLLABUS

UNIT I [8 Hrs]

Basic MOS Device Physics : General Considerations: MOSFET as a Switch, MOSFET Structure, MOS Symbols, MOS I/V Characteristics: Threshold Voltage, Derivation of I/V Characteristics, Second-Order Effects, MOS Device Models: MOS Device Layout, MOS Device Capacitances, MOS Small Signal Model, NMOS versus PMOS Devices, Long Channel Devices versus Short Channel Devices.

UNIT II [10 Hrs]

Single-Stage Amplifiers : Basic Concepts, Common-Source Stage: Common-Source Stage with Resistive Load ,CS Stage with Diode-Connected Load, CS Stage with Current-Source Load, CS Stage with Source Degeneration. Source Follower, Common-Gate Stage, Cascode Stage, Folded Cascode Amplifiers.

UNIT III [12 Hrs]

Differential Amplifiers: Single ended and differential operation. Basic Differential Pair, Qualitative Analysis, Quantitative Analysis, Gilbert cell,Differential Pair with MOS Loads.

Frequency Response of Amplifiers: General Considerations, Miller Effect, Association of Poles with Nodes, Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair.

UNIT IV **[10 Hrs]**

Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors, Large-Signal Analysis, Small-Signal Analysis, Common-Mode Properties.

UNIT V **[10 Hrs]**

Operational Amplifiers: General considerations of Op-Amps, One stage Op-Amps, Two Stage Op-Amps, Gain Boosting, Comparison, and Input range Limitation, Slew rate

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

COs	Description	Blooms Level
CO 1	Explain the small- and large-signal models of CMOS transistors	II-Understanding
CO 2	Demonstrate single stage amplifiers with different loads	II-Understanding
CO 3	Design and analyze differential amplifiers and current mirror circuits.	VI-Creating
CO 4	Analyze Frequency response of amplifiers.	IV-Analyzing
CO 5	Design and implementation of operational amplifiers	VI-Creating

Mapping of Cos to Pos

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3												3
CO 2	3													
CO 3	3			3		3						3	3	
CO 4	3			3		3						3		
CO 5	3								3			3	3	3

Text Books

T1. BehzadRazavi, "Analog CMOS Integrated Circuits", 2nd Edition, McGraw Hill, 2017.

T2. Kenneth Martin, "Analog Integrated Circuit Design", 2nd Edition Wiley Publications, 2013.

Reference Books

R1. Paul. R. Gray, Paul. R. Hurst, Stephen H. Lewis & R. G. Meyer, "Analysis and Design of Analog Integrated Circuits", 5th Edition, John Wiley Publications, 2010.

R2. Sedra and Smith, "Microelectronic Circuits', 6th Edition, Oxford Publications, 2013.

VLSI DESIGN LAB

Subject Code: UGEC6P0822	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**1.5**

Prerequisites

- Digital Logic Design
- VLSI Design

Laboratory Objectives:

The objective of this lab is

- To set up an own design library
- To familiarize with a full custom IC design flow.

DEMONSTRATION:

1. Introduction to LINUX environment
2. Introduction to Cadence Virtuoso

EXPERIMENTS (At Least 10 Experiments)

PART A: (At Least 8 Experiments)

1. NMOS and PMOS Characteristics
2. CMOS inverter static and dynamic characteristics
3. Design and implementation of universal gates
4. Design and implementation of Adders
    i. Half Adder
    ii. Full adder
5. Design and implementation of Decoder
6. Design and implementation of Multiplexer
7. Design and implementation of Comparator
8. Design and implementation of D Flip-flop
9. Design and implementation of shift register
10. Design and implementation of counter

PART B: (At Least 2 Experiments)

1. Create a layout for CMOS inverter, perform layout verification and parasitic extraction from layout
2. Create a layout for NAND gate and perform layout verification and parasitic extraction from layout.
3. Create a layout for NOR gate and perform layout verification and parasitic extraction from layout.

Laboratory Outcomes: Upon completion of the course, students will able to

LO'S	**Description Blooms Level**	**Blooms Level**
L01	Build pre-layout simulations using Spectre.	III -Applying
L02	Apply Layout specific rules using Cadence virtuoso	III -Applying
L03	Compile post layout simulation by extracting the net list	VI- Creating
L04	Build any digital circuit on silicon using state-of-the art.	VI- Creating

Mapping of LOs to POs

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
LO1		3			3				2					
LO2		3		3	3				2			2	2	
LO3		3		3	3				2			2	2	
LO4		3		3	3				2			2		3

ARM LAB

Subject Code: UGEC6P0922	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**1.5**

Prerequisites

- Problem Solving with 'C'
- Digital Logic Design

Laboratory objectives

- To develop programming of ARM Processor.
- Providing the basic knowledge of interfacing various peripherals to Raspberry pi.

Experiments

Part-A (Minimum Any 5 Experiments)

1. Write a Program to interface the following with ARM Processor.
    a. LED
    b. RGB LED
2. Write a Program to interface Push Button with ARM Processor.
3. Write a Program to Interface LCD with ARM Processor.
4. Write a Program to Interface Seven Segment Display with ARM Processor.
5. Write a Program to Interface DC Motor and Servo Motor with ARM Processor.
6. Write a Program to Interface Keypad with ARM Processor.

Part-B (Minimum Any 5 Experiments)

1. Design an Application and develop Bluetooth interface using Raspberry pi.
2. Design an Application and develop STM 32 with Bluetooth Low Energy (BLE) using Raspberry pi.
3. Design an Application and develop Embedded peripherals like RTC, Timer, Watchdog using Raspberry pi.
4. Design an Application and develop Modem & Network Interface experiments using Raspberry pi.
5. Design an Application and develop protocols like I2C, SPI using Raspberry pi.
6. Design an Application and develop Linux Kernel Interface using Raspberry pi.

Laboratory Outcomes: Upon completion of the course the student will be able to

LOs	Description	BLOOMS Level
LO1	Understand the concepts of ARM processor and several types of I/O Devices.	II-Understand.
LO2	Construct interfacing circuits for different Applications.	III-Applying
LO3	Develop peripherals for different applications using Raspberry pi.	VI-Creating
LO4	Develop Real time applications using Raspberry pi.	VI-Creating

Mapping of COs to Pos

LOs/POs	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
LO1	3	3										3	3	
LO2				3	3						3			
LO3		3			3				3		3	3		
LO4			3	3					3		3	3	3	

EM WAVES LAB

Subject Code : UGEC6P1022	**L**	**T**	**P**	**C**
III Year/ II Semester	**0**	**0**	**3**	**1.5**

Prerequisites

- Electromagnetic Waves

Laboratory objectives : The objectives of this laboratory are

- To introduce experimental exposure to the students about the different antenna radiation pattern measurement.
- To introduce experiments on design and simulation of various high frequency components using high frequency simulator.

Demonstration : Study of Different types of Antennas and Microwave Bench

Experiments (Any 10 Experiment)

Part – A

1. Measurement of Radiation Pattern of Dipole Antenna
2. Measurement of Radiation Pattern of Loop Antenna
3. Measurement of Radiation Pattern of Yagi-Uda Antenna
4. Measurement of Radiation Pattern of Log Periodic Antenna
5. Measurement of Radiation Pattern of Horn Antenna
6. Measurement of Gain of Horn Antenna
7. Measurement of Radiation Pattern of Microstrip Antenna
8. Measurement of reflection coefficient of microsrtip Antenna using Network Analyzer
9. Measurement of Impedance for microsrtip Antenna
10. Measurement of S Parameters of microsrtip Components using Network Analyzer

Part -B

11. Design and Simulation of Rectangular Waveguide
12. Design and Simulation of Dipole Antenna
13. Design and Simulation of Microstrip Antenna

LOS	Description	Bloom'sLevel
LO 1	Measure and plot the radiation characteristics of wire antennas	III-Applying
LO 2	Make Use of microwave test bench to measure and plot the radiation characteristics of waveguide antennas	V-Evaluating
LO 3	Make use of Network Analyzer to verify the S-parameters Of microstrip components	III-Applying
LO 4	Design and simulate various antennas and waveguide	VI-Creating

Mapping of Los to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
LO 1	3	3							3	3				
LO 2	3	3	3						3	3			3	
LO 3	3	3	3						3	3			2	
LO 4	3								3	3			3	

ADVANCED COMMUNICATION SKILLS

Subject Code: UGBS6K0122	**L**	**T**	**P**	**C**
III Year / II Semester	**1**	**0**	**2**	**2**

Prerequisite: Basic competency skills in English for effective communication at work place.

Course Objectives:

- To expose students to LSRW skills at an advanced level.
- To prepare students to acquire correct body language for better oral communication.
- To prepare students to develop debatable skills, presentation as well as interview skills.

Syllabus:

UNIT-I :	Business E-mail Writing	(9 Hours)
UNIT-II :	Presentation skills	(9 Hours)
UNIT-III :	Group Discussion	(9 Hours)
UNIT-IV :	Resume Writing	(9 Hours)
UNIT-V :	Interviews	(9 Hours)

Course Outcomes:

Upon the completion of the course, students will be able to:

CO1: Develop the skill of writing business e-mails. (L3)
CO2: Apply presentation skills for effective presentations. (L3)
CO3: Employ various aspects of group discussion and apply in discussions. (L3)
CO4: Develop the skill of writing resumes contextually and effectively. (L3)
CO5: Discover techniques for various types of interview for facing career interviews. (L3)

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	-	3	-	3
CO2	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-

TEXT BOOKS:

1. Soft Skills – Key to Success in Workplace and Life – Meenakshi Raman & Shalini UpadhyayCengage publications
2. Interact – Orient BlackSwan

REFERENCE BOOKS:

1. Fluency Development Course – Kev Nair (Kerala)
2. Speaking English Effectively – Krishna Mohan & N P Singh – Macmillan Indian Ltd. Group Discussion for Admissions & Jobs – Anand Ganguly – Pustak Mahal Publishers, New Delhi

INTERNET SOURCES:

1. BBC Learning English at work:
   http://www.bbc.co.uk/learningenglish/features/english-at-work/18-writing-an-email
2. Talkenglish.com:
   https://www.google.com/search?client=firefox-b-&q=talk+english.com
   Actual English – Jennifer (Video lessons)

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
(Common to all branches)

Subject Code: UGBS6A0222	**L**	**T**	**P**	**C**
III Year / II Semester	**2**	**0**	**0**	**0**

Course Objectives:
This course offers an introduction to Indian philosophy, tradition of Indian Science and Mathematics, holistic approach to health and gender sensitization.

Syllabus

UNIT-I: INDIAN PHILOSOPHY
Origin of Indian philosophy- philosophy of Charvaka, Samkhya, Nyaya, Mimensa, Buddist and Jaina.

UNIT-II: TRADITION OF INDIAN SCIENCE
Historical evolution of medical tradition in ancient India.
Ayurveda: Principles of Ayurvedic Healing -Treating diseases to restore health.
Environmental Knowledge: Nature, flora and fauna, Manusmriti.

UNIT-III: TRADITION OF INDIAN MATHS
Early Historical period, Classical period, Vedic mathematics, Baskaracharya, Lilavati Bijaganitha, Srinivasa Ramanujan - Magic squares.

UNIT-IV: HOLISTIC HEALTH
History, Holistic approach: Enhance living – Mind fullness skills- Spirituality and Healing, Stress Management - Food—Work and Life style.
Yoga –Healthy Body: Introduction to Yoga, - Pranayamam, Surya Namaskara and Personality Development.

UNIT-V: GENDER SENSITIZATION
Basic Gender concepts and terminology, Exploring attitudes towards Gender, Making Women, Making Men, Preparing for Womanhood.
Struggles with discrimination, Gender Roles and Relations, Gender and Human Rights, Types of Gender-based violence, Gender-based violence from a Human Rights perspective, Sexual Harassment, Gender and Media.

Course Outcomes:
Upon completion of this course, the students will be able to:
CO 1. Summarize the essence of Indian philosophy.
CO 2. Outline the tradition of Indian Science and Mathematics.
CO 3. Make use of holistic health practices, spirituality, stress management techniques for healthy life Style and Yoga practices to attain good personality.
CO 4. Develop awareness with regard to issues of gender.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	-	3	-	-	-	-
CO2	-	-	-	-	-	3	-	-	-	-	-	3
CO3	-	-	-	-	-	3	-	-	-	-	-	3
CO4	-	-	-	-	-	3	-	3	-	-	-	-

TEXT BOOKS:

1. "Traditional Knowledge System in India" by Amit Jha, 2009.
2. "Traditional Knowledge System and Technology in India", Basanta Kumar Mohantra, Vipin Kumar Singh, Pratibha Prakashan publisher, 2012.
3. "Towards a World of Equals: A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi.
4. "Gender Sensitization" by C. Rajya Lakshmi Kalyani, D.S. Vittal, published by Himalaya Publishing House Pvt. Ltd.

REFERENCES:

1. "Knowledge Traditions and Practices of India", Kapil Kapoor, Michel Danino.
2. S. Radhakrishna, Indian Philosophy, Vol. 1 (London: George Allen and Unwin,1962), 287.
3. J. P. Jain, Religion and Culture of the Jains (Delhi: Bhartiya Jnanpith, 1977) 168
4. D. P. Sen Gupta, Current Science, 78 (12), 1569 (2000)
5. C.N.Srinivasa Iyengar, History of Indian Mathematics, World Press, Calcutta, 1967.
6. G. H Hardy, Ramanujan (Cambridge, 1940).
7. Nutritive Value of Indian Foods, C.Gopalan, B.V.Raman Sastri & S.C. Balasubramanian.
8. George Feuerstein: The Yoga Tradition (Its history, literature, philosophy and practice)
9. Swami Sivananda, Practice of Karma Yoga (The Divine Life Society, Shivananda Nagar, P.O., U.P., Himalayas, India)
10. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
11. IGNOU : Gender Sensitization: Society, Culture and Change (2019) BGSE001, New Delhi IGNOU
12. Jane Pilcher and Imelda Whelehan (2005) : Fifty Key Concepts in Gender Studies