Pandit Deendayal Energy University

School of Technology

Department of Information and Communication Technology

Under Graduate Curriculum Handbook (Academic Year 2024-28)

B.Tech. (Information and Communication Technology) w. e. f. July, 2024.

Department of Information and Communication Technology (ICT)

School of Technology, PDPU

Vision:

- Build a teaching and research ecology which promotes innovations, results in societal transformation and sustainable development.

Mission:

- Strive and sustain intrinsically motivated learning and research environment focusing on Innovative Technologies, Information and Communication Technology infrastructure and services.
- Provide quality undergraduate and graduate education to create future technocrats for societal transformation.
- Develop collaborations with all stakeholders and undertake real-world projects leading to sustainable development.

Program Educational Objectives (PEOs):

- Prepare professionals for industry, research organizations and academia in the field of Information and Communication Technology.
- Impart knowledge and technical skills to students for contribution to the design and development in Computer Science and Information Technology, Communication and Signal Processing, and Electronic Systems.
- Motivating graduates for lifelong learning with leadership qualities, ethics and life skills.

Program Outcomes (POs):

The graduates of ICT department will be able to:

1. ***Engineering knowledge:*** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. ***Problem analysis:*** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. ***Design / development of solutions:*** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

4. ***Conduct investigations of complex problems:*** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

5. ***Modern tool usage:*** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. ***The engineer and society:*** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. ***Environment and sustainability:*** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

8. ***Ethics:*** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. ***Individual and team work:*** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

10. ***Communication:*** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. ***Project management and finance:*** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member and leader in a team, to manage projects in multidisciplinary environments.

12. ***Life-long learning:*** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

The graduates of ICT department will be able to:

1. Apply ICT knowledge to solve multidisciplinary problems using tools and technologies.
2. Understand, analyze and evaluate the impact of Information and Communication Technology on Environment, Energy, Infrastructure and Economy.
3. Contribute to environment, society and industries by providing solutions spanning Computer Science and Information Technology, Communication and Signal Processing, and Electronic Systems.

Course Outline

Sem		Course Name	Th	Tut	Pra	Hrs	Cr
Sem I	HSC	Humanities – 1	2	0	0	2	2
	BSC	Mathematics – 1	3	1	0	4	4
	BSC	Physics	3	0	0	3	3
	BSC	Physics – Laboratory	0	0	2	2	1
	BSC	Environment Science	2	0	0	2	2
	ESC	Workshop Practices	0	0	2	2	1
	BSC	Biology for Engineers	2	0	0	2	2
	ESC	Computer Programming -I	1	0	0	1	1
	ESC	Computer Programming -I Laboratory	0	0	2	2	1
	HSC	Universal Human Values	1	0	0	1	1
	HSC	Indian Knowledge System	2	0	0	2	2
			16	**1**	**5**	**23**	**20**
Sem II	HSC	Humanities – 2	2	0	0	2	2
	BSC	Mathematics – 2	3	1	0	4	4
	BSC	Chemistry	3	0	0	3	3
	BSC	Chemistry – Laboratory	0	0	2	2	1
	ESC	Introduction to Electrical Engineering	3	0	0	3	3
	ESC	Introduction to Electrical Engineering-Laboratory	0	0	2	2	1
	ESC	Engineering Graphics	0	0	4	4	2
	HSC	Yoga, Health & Hygiene OR NCC/NSS	0	0	2	2	1
	HSC	Organizational Behaviour	1	0	0	1	1
	ESC	Computer Programming -II	1	0	0	1	1
	ESC	Computer Programming -II Laboratory	0	0	2	2	1
			13	**1**	**12**	**26**	**20**
Sem III	Pro	Civic and Social Service Internship	0	0	0	0	1
	ESC	Introduction to Artificial Intelligence (Department Specific)	3	0	0	3	3
	PC	Digital Circuits	3	0	0	3	3
	PC	Digital Circuits Laboratory	0	0	2	2	1
	PC	Data Structures and Algorithms	3	0	0	3	3
	PC	Data Structures and Algorithms Laboratory	0	0	2	2	1
	PC	Fundamentals of ICT	2	0	0	2	2
	PC	Electronics Devices and Circuits	2	0	0	2	2
	BSC	Discrete Mathematical Structures	3	1	0	4	4
			16	**1**	**4**	**21**	**20**
Sem IV	ESC	Industry 4.0 (Department Specific)	2	0	0	2	2
	ESC	Industry 4.0 – Laboratory (Department Specific)	0	0	2	2	1
	OE	Open Elective 1 (From Other School)	3	0	0	3	3
	PC	Database Management Systems	3	0	0	3	3
	PC	Database Management Systems Laboratory	0	0	2	2	1
	PC	Principles of Programming Languages	3	0	0	3	3
	PC	Principles of Programming Languages Laboratory	0	0	2	2	1

	PC	Fundamentals of Signal Processing & Communication	3	1	0	4	4
	PC	Computer Organization & Microprocessor	3	0	0	3	3
	PC	Computer Organization & Microprocessor Laboratory	0	0	2	2	1
			17	**1**	**8**	**26**	**22**
Sem V	OE	Open Elective 2 **((NPTEL/SWAYAM/MOOC))**	3	0	0	3	3
	HSC	Engineering Economics	3	0	0	3	3
	PE	Program Elective 1	3	0	0	3	3
	PC	Theory of Computation & Compiler Design	3	0	0	3	3
	PC	Theory of Computation & Compiler Design Laboratory	0	0	2	2	1
	PC	Digital Signal Processing	3	0	0	3	3
	PC	Digital Signal Processing Laboratory	0	0	2	2	1
	PC	RF Engineering	3	0	0	3	3
	PC	RF Engineering Laboratory	0	0	2	2	1
			18	**0**	**6**	**24**	**21**
Sem VI	OE	Open Elective 3 (From Other Department of FoET)	3	0	0	3	3
	PE	Program Elective 2	3	0	0	3	3
	PE	Program Elective 3	3	0	0	3	3
	PC	Operating Systems	3	0	0	3	3
	PC	Operating Systems Laboratory	0	0	2	2	1
	PC	Digital Communication	3	0	0	3	3
	PC	Digital Communication Laboratory	0	0	2	2	1
	PC	Computer Communication and Networking	3	0	0	3	3
	PC	Computer Communication and Networking Laboratory	0	0	2	2	1
			18	**0**	**6**	**24**	**21**
Sem VII	Pro	Summer Internship	0	0	0	0	2
	OE	Open Elective 4 (From Other Department of FoET)	3	0	0	3	3
	PE	Program Elective 4 (3-0-0)	3	0	0	3	3
	PE	Program Elective 5 (3-0-0)	3	0	0	3	3
	PC	Software Engineering Methodology	3	0	0	3	3
	PC	Software Engineering Methodology Laboratory	0	0	2	2	1
	PC	Embedded Systems	3	0	0	3	3
	PC	Embedded Systems Laboratory	0	0	2	2	1
	PC	Digital CMOS and VLSI Design	3	0	0	3	3
	PC	Digital CMOS and VLSI Design Laboratory	0	0	2	2	1
		Seminar					1
			18	0	6	24	24
Sem VIII		**Course Name**	**Th**	**Tut**	**Pra**	**Hrs**	**Cr**
	Pro	Major/Comprehensive Project					**12**

Program Core Electives:

Semester	Software and Networks	Artificial Intelligence	Communication and Signal Processing	Embedded and VLSI
5 (program core elective1)	Web Technology	Optimization methods and Algorithms		Introduction to CMOS and Memory Technology
	Problem solving through Java			
6 (program core elective2, 3)	Cloud Architecture and Service	Machine Learning	Image Processing	Hardware Accelerated Computing
	Advanced Web Technology	Data warehousing & Mining	Statistical Signal Processing	
	Advanced Algorithm Design			
7 (program core elective4, 5)	Cryptography and Network Security	Computer Vision	Optical Communication	Autonomous systems
	Internet of Things	Deep Learning and Reinforcement learning	Modern Wireless Communications	Hardware Accelerated Computing
	Blockchain Technology			Real time Operating Systems
	Mobile Application Development			

1st Semester

UG_1_T(CSE/ICT/EC/EE)					Computer Programming-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

- To understand the usage of operators and data types.
- To apply different types of Conditional and looping statement.
- To create different types of data collections.
- To implement user defined function.
- To perform different operations upon files.

UNIT 1: Basics of Programming Introduction to Computer Programming, Features of C language, Structure of C program, program execution flow, C Tokens, variables, Data types, Operators, Decision control statements-if, switch, go to statement. Loop control structures- while, do-while, for loop, Break statement, Continue statement	**3 Hrs.**
UNIT 2: Derived Data types Array: one dimensional and multidimensional array, Declaration, initialization, Array Manipulations. Matrix operations, String-Basic Concepts, Inbuilt String manipulation Functions, Pointer, Pointer arithmetic, Pointer to pointer, Array of Pointers, Dynamic memory allocation.	**4 Hrs.**
UNIT 3: Function and Structure Introduction to user defined functions, Types of Functions, Call by value-call by reference, recursion, pointers to functions, Structures, Self-referential structures, typedef, Array of Structure, Union	**4 Hrs.**
UNIT 4: Basics of Files and Data Structures File handling in C, Different types of files, Operations on Files, File handling functions. Data Structure, definition, Types of data structures, Applications of data structures	**3 Hrs.**
	14 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand basics of programming.
CO2 - Identify different programming constructs for a problem.
CO3 - Apply appropriate derived data type for data storage.
CO4 - Prepare a user defined data type based on data attributes.
CO5 - Construct user defined functions for problem solving.
CO6 - Analyse different data structure based on application requirement.

TEXT/REFERENCE BOOKS

1. Kernighan & Ritchie, C Programming Language", PHI
2. K. N. King , "C Programming: A Modern Approach" , W.W. Nortorn
3. David Griffiths and Dawn Griffiths, "Head First C: A Brain-Friendly Guide", O'Reilly
4. E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
5. Y.P. Kanetkar ,"Let us C", BPB Publication
6. Y.P. Kanetkar , "Pointers in C", BPB Publications

UG_1_P(CSE/ICT/EC/EE)					Computer Programming – I Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To implement basic programming concepts.
- To create different types of data collections.
- To implement user defined function.
- To perform different file handling operations.

LIST OF EXPERIMENT

1.	**Introduction to Computer Programming**: Getting acquainted with Linux Terminal and basic commands, understanding compilation process through a simple C program, program execution flow, C Tokens, variables and keywords and identifiers, types of C constants and variables
2.	**Simple and formatted Input Output Operations:** Data types, Operators, Input /output statements in C, Formatted I/O, format specifiers, escaper sequences
3.	**Decision making and branching:** if, if-else, if-else ladder, switch, go to statement, conditional operator statement
4.	**Looping control structures:** while, do-while, for loop, Break statement, Continue statement
5.	**Basics of modular programming:** Introduction to modular programming through basic function syntax, introduction to header file creation, difference between #include <filename> and #include "filename"
6.	**Derived Data Type: Array and Strings:** One dimensional and multidimensional array, Declaration, initialization, Array Manipulations. Matrix operations, Basic Concepts, Inbuilt String manipulation with and without using inbuilt functions.
7.	**Derived Data Type: Structure and Union:** structure, arrays and structures, structures and functions, pointer to structure, self-referential structures, typedef, unions
8.	**Functions:** Introduction to user defined functions, Types of Functions, Call by value-call by reference, static and external variables, header file creation, recursion, pointers to functions, arrays and functions
9.	**Pointers:** Pointers basics, use of &, * operator in context to pointers, Pointer arithmetic, Array and String processing using pointer, pointer to pointer, Array of Pointers
10.	**File Handling in C:** File handling in C, Different types of files, Operations on Files, File handling functions.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the use of appropriate naming conventions and programming style including appropriate comment density.
CO2 - Implement a basic C program using appropriate control structure.
CO3 - Apply appropriate derived data types based on data attributes.
CO4 - Develop the problem solution modularly.
CO5 - Design user defined functions for problem solving and reuse them across different programs.
CO6 - Apply suitable file handling and data structures.

TEXT/REFERENCE BOOKS

1. Kernighan & Ritchie, C Programming Language", PHI
2. K. N. King , "C Programming: A Modern Approach", W.W. Norton
3. E. Balaguruswamy, Programming in ANSI C, McGraw-Hill
4. Y.P. Kanetkar,"Let us C", BPB Publication
5. Y.P. Kanetkar, "Pointers in C", BPB Publication

2nd Semester

Pandit Deendayal Energy University School of Technology

UG_2_T(CE/ICT/EC/EE))					Computer Programming-II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

- To impart the basic concepts of Python Programming language
- To be familiar with data structures available in Python.
- To understand the concept of function & object-oriented programming.
- To use the file and exception handling for designing applications

UNIT 1: Introduction and Language Fundamentals **Introduction**: Definition and its historical background, Comparison with other programming languages. Python IDEs **Tokens:** Identifiers, Keyword **Data Types:** Int, Float, Bool, Complex, Str, List, Tuple, Dictionary and Set, Type conversion, Concept of mutability, immutability and reusability **Operators:** Arithmetic, Relational, Logical, Identity and Membership, Input and Output methods Control Flow Conditional statements: If, elif and else, nesting, Iterative or loop statement: for, while, for else and while else, Transfer statements: break, continue, pass.	**4 Hrs.**
UNIT 2: Functions Function Declaration and calling, Types of Function arguments, scope of variable, Recursive function Recursive function **Types of function:** Anonymous or lambda, Map, Filter, Reduce, Function aliasing, Nested function, Decorator function, Decorator chaining Generator function	**3 Hrs.**
UNIT 3: Object Oriented Programming Class, Object, Object reference, Constructor and self-variable, Types of variables, Types of method, Destructor, Composition, Aggregation, Inheritance, Polymorphism, Abstract classes.	**4 Hrs.**
UNIT 4: Modules, File and Exception Handling **Modules & Package** User defined module, imports, important functions for module, User defined package creation, module and package use cases **File handling** Types of files, writing and reading with text file, important functions of file handling, working with directories, CSV file handling, pickling and unpickling **Exception Handling** exceptions handling using try-except blocks. Raising exceptions and custom exception classes.	**3 Hrs.**
	Max. 14 Hrs.

COURSE OUTCOMES

CO1 - Understand the basic concepts of programming with python.
CO2 - Demonstrate proficiency in using different data types, operators, and control structures in Python programs.
CO3 - Demonstrate the usage of both built-in and user-defined functions
CO4 - Define and use classes in Python to represent attributes and methods, and demonstrate composition, aggregation, inheritance and polymorphism.
CO5 - Implement exception handling mechanisms to deal with errors.
CO6 - Demonstrate the use of module and packages.

TEXT/REFERENCE BOOKS

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.
3. Al Sweigart, “Automate the Boring Stuff with Python”
4. Martin C. Brown, “Python: The Complete Reference, Osborne, McGraw-Hill
5. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press

UG_2_L(CE/ICT/EC/EE))					Computer Programming-II Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	100

COURSE OBJECTIVES

- To impart the basic concepts of Python programming language
- To be familiar with data structures available in Python.
- To understand the concept of function & object-oriented programming.
- To use file and exception handling for designing applications

LIST OF EXPERIMENT

1.	**Language fundamentals**: Understanding interpretation, program execution flow, tokens, variables and keywords and identifiers, constants and variables
2.	**Input Output Operations:** Basic data types, mutability, immutability, Operators, Input /output statements, format specifiers, escape sequences
3.	**Decision making, Looping control structures** If, elif and else, nesting, Iterative or loop statement: for, while, for else and while else, Transfer statements: break,
4.	**Advanced datatypes:** String, List, Tuples, Dictionary, Set
5.	**Functions:** Basics of functions, types of arguments
6.	**Types of functions** Anonymous function, function aliasing, nested function, decorator function and generator function
7.	**Object Oriented programming** class, object, types of variable and methods, composition, aggregation, inheritance, types of inheritance
8.	**Modules & Packages** Creation of user defined module, various types of imports, creation of user defined package
9.	**File Handling:** writing and reading with text file and csv file, working with directories, pickling and unpickling
10.	**Exception Handling** try-except blocks, raising exceptions, custom exception classes.

COURSE OUTCOMES

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

CO1 - Apply the concepts of variables, decision making and looping with python.
CO2 - Apply various data structures available in Python to solve computational problems.
CO3 - Implement advanced function concepts such as decorator chaining and generator functions.
CO4 - Design and implement object-oriented solutions to programming problems using composition, aggregation, inheritance and polymorphism.
CO5 - Develop Python scripts, for file handling tasks.
CO6 - Create the console application and manage them in the form of modules and packages.

TEXT/REFERENCE BOOKS

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.
3. Al Sweigart, “Automate the Boring Stuff with Python”
4. Martin C. Brown, “Python: The Complete Reference, Osborne, McGraw-Hill
5. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press

24EE101T					Elements of Electrical and Electronics Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1 To impart knowledge on DC and AC circuits.
2 To learn construction, working principle and characteristics of transformer and induction machines.
3 To introduce students to various means for electrical safety, protection of electrical installations and Batteries
4 To understand rectification through p-n junction diode, applications of diode and Transistor Characteristics

UNIT I: DC CIRCUITS **10 Hrs**

Electrical circuit elements (R, L and C), voltage and current sources, dependent and independent sources, Ohms Law, temperature co-efficient of resistance, Kirchhoff current and voltage laws, voltage and current divider circuit, Thevenin and Norton Theorems and their equivalents, maximum power transfer and superposition theorems, nodal and mesh analysis, star-delta transformation, Time domain analysis/natural response of first order RL and RC Circuit

UNIT II: AC CIRCUITS **10 Hrs**

Generation of AC voltage, representation of sinusoidal waveforms, RMS values of different sinusoidal waveforms, Rectangular and Polar representation of phasor, Sinusoid representation in time and frequency domain, Analysis of single-phase ac series circuits consisting of R, L, C, RL, RC, RLC combinations, instantaneous power, average power and reactive power, complex power and power factor.AC parallel circuit and its solution in admittance form, resonance in AC series and parallel circuits, polyphase circuits, star and delta representation of polyphase circuits, power measurement in polyphase circuits.

UNIT III: INTRODUCTION TO ELECTRICAL MACHINES AND ELECTRICAL INSTALLATION **12 Hrs**

Magnetic materials and its B-H characteristic, Faraday's Law of Electromagnetic Induction; **Single Phase Transformers:** Construction, working principle, types, EMF equation, ideal transformer, practical transformer, Operation of transformer on no-load and load, **Induction Machine:** construction, types of 3-phase induction motors, working principle, production of rotating magnetic field, operation, starting and running torques, Torque-slip characteristics, Power Stages in an induction motor.

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing, Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, Electrical safety rules.

UNIT IV: BASIC OF ELECTRONICS AND ELECTRICAL INSTALLATION **10 Hrs**

Semiconductor Diodes and Applications, Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices–LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications.

Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Field Effect Transistor (FET) – Construction, Characteristics of Junction FET.

TOTAL HOURS 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1	–	Understand electrical circuits using network theorems.
CO2	–	Compare the behaviour of R, L and C and their combinations in AC circuits.
CO3	–	Analyze balanced polyphase systems in star and delta configurations
CO4	–	Understand the construction, working and basic characteristics of transformer and induction machines
CO5	–	Recognize the importance of protective devices, electrical safety measures and characteristics of Batteries
CO6	--	Demonstrate application of different diodes in circuits and Understand the Transistor characteristics

TEXT/REFERENCE BOOKS

1. J. Bird, **"Electrical Circuit Theory and Technology"**, Routledge, Tailor and Francis Group, Sixth Edition, 2017.
2. D. P. Kothari and I. J. Nagrath, **"Basic Electrical Engineering"**, Tata McGraw Hill, 2010.
3. B. L. Theraja, **"Electrical Technology",** Vol. 1, S. Chand Publication, New Delhi.

4. Surjit Singh, **"Electrical Estimating and Costing"**, Dhanpat Rai and Co.
5. Boylestad and Nashlesky, "Electronic Devices and Circuit Theory", PHI

24EE101P					Elements of Electrical and Electronics Engineering Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To gain practical knowledge on DC and AC circuits
- To learn operation of electrical instruments and electrical machines
- To introduce students to various means for electrical safety, protection of electrical installations
- To understand characteristics and applications of semiconductor diodes and transistors.

LIST OF EXPERIMENTS

1. Introduction to elements of electrical engineering laboratory and to study different electrical measuring instruments.
2. To Verify Ohm's law with linear resistors and find power dissipation in resistor.
3. To validate Thevenin and Norton theorem for DC circuits.
4. To validate Superposition and Maximum Power Transfer theorem for DC circuits.
5. To evaluate the AC R, L and R-L series circuit performance and to measure the active power, the reactive power and the apparent power connected with single phase AC supply.
6. To evaluate performance of AC R-L parallel circuit and to measure the active power, the Reactive power and the apparent power connected with single phase AC supply.
7. To perform a direct load test on a single-phase transformer and determine the efficiency and voltage regulation at different loads.
8. To measure three phase power using two wattmeter method.
9. To draw the time-current characteristics of MCB and study the function of ELCB.
10. To obtain the VI characteristic of silicon and germanium diodes.
11. To obtain reverse characteristics of Zener diode.
12. To study half wave, full wave and bridge rectifiers.
13. To determine the DC Characteristics of BJT in CE Configuration.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – To understand the basic operation of electrical equipment's & measuring instruments.
CO2 – To perform various network theorems for DC circuits.
CO3 – To understand the performance of AC circuit with R, L load.
CO4 – To evaluate star and delta configuration of polyphase system and measure power in polyphase system.
CO5 – To evaluate the performance of single-phase transformer.
CO6 – To understand the working principle of semiconductor diodes, transistor characteristics and its applications.

3rd Semester

24ICxxxT					Digital Circuits					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	0	0	100

COURSE OBJECTIVES

- To learn the fundamentals of digital logic circuits and digital number systems.
- To be able to analyze and design digital combinational-logic and sequential-logic circuits.
- To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines.

UNIT-1: NUMBER SYSTEMS AND LOGIC GATES **8 Hrs.**
Digital systems; positional number system; binary, octal and hexadecimal representation of integer/fixed-point numbers; Methods of base conversions; complements; Representation of signed numbers; signed/unsigned binary, octal and hexadecimal arithmetic; Binary coded decimal codes; Gray codes; Excess-3 codes, Logic Gates, and Truth Table; Error detection and correction codes - parity check codes and Hamming codes.
UNIT-2: BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS **14 Hrs.**
Boolean Algebra & Simplification of Boolean Algebra: Basic postulates and fundamental theorems of Boolean algebra; Representation of logic functions: canonical and standard forms; Simplification of Boolean functions: K-map and Quine-McCluskey tabular methods.
Definition of combinational circuits; design procedure; Decoders; encoders; multiplexers; demultiplexers and their applications; Parity generator and checker circuits; comparators; Arithmetic modules- ripple carry adder, subtractor, carry look ahead adder; basic multiplier, BCD Adder; Shannon expansion theorem.
UNIT-3: SEQUENTIAL CIRCUITS **14 Hrs**.
Definition of sequential circuits; Latches and flip-flops: SR-latch; D-latch; D flip-flop; JK flip-flop; T flip-flop.
Synchronous sequential circuit; Moore and Mealy Finite State Machines (FSM): state diagram, state table, state assignment; Analysis and implementation of FSM using D flip-flops, JK flip-flops and T flip-flops; Implementation of FSM using Decoders, OR gates, Multiplexors and ROM.
Various Registers and counters: asynchronous counters, synchronous counters; ring counter, Johnson counter.
UNIT 4: INTRODUCTION TO MEMORY AND PROGRAMMABLE LOGIC CIRCUITS **6 Hrs**.
Introduction, Random access memory, read only memory, programmable logic array, programmable array logic, sequential programmable devices, FPGA. **Max. Hrs.: 42**

COURSE OUTCOMES

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

CO1: Study the basics of number systems, Boolean algebra and standard digital logic gates.
CO2: Understand the knowledge of Boolean Algebra and simplification of Boolean expressions to deduce optimal digital networks.
CO3: Apply the knowledge to synthesis combinational circuits.
CO4: Analyse the operation and logic circuits of basic storage elements FFs.
CO5: Implement SSI and MSI digital networks given a state diagram based on Mealy and Moore configurations.
CO6: Design and examine the SSI, MSI and Programmable combinational networks.

TEXT/REFERENCE BOOKS

1. Digital Design - M. Morris Mano and Michael Ciletti, 5 th edition, Pearson.
2. Switching Theory and Logic Design - A. Anand Kumar, PHI, 2nd Edition.
3. Fundamentals of Digital Logic with Verilog Design - Stephen Brown and Zvonko Vranesic Tata McGraw Hill.
4. Switching and Finite Automata Theory - Zvi Kohavi & Niraj K. Jha, 3rd Edition, Cambridge.
5. Fundamentals of Logic Design - Charles H. Roth, Cengage LEanring, 5th, Edition.
6. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc.
7. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson.

24ICxxxP					Digital Circuits Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES:

- To learn the fundamentals of digital logic design and digital circuits.
- To be able to analyze and design digital combinational-logic and sequential-logic circuits.
- To be able to implement digital combinational-logic and sequential-logic circuits.

List of Experiments

1. Study of Different types of logic gates and implement them using NAND and NOR gates.
2. Design a simple combinational circuit with four variables and obtain minimal expression and verify the truth table.
3. Study of Half and full adder circuits.
4. Study of Binary and BCD parallel adder circuits.
5. Study of Decoder and Encoder circuits.
6. Study of Multiplexer and De-multiplexer circuits.
7. Study of Different types of flip flops.
8. Study of Asynchronous and synchronous binary counters.
9. Study of Various types of registers.
10. Design a BCD to 7-segment display decoder circuit and interface with a 7-sgment display.

COURSE OUTCOMES

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

CO1 - Remember digital logic circuit functionalities
CO2 - Understand the design methodologies to utilize them practically.
CO3 - Apply design methods to realize digital circuits practically.
CO4 - Analyze functionalities of digital circuits.
CO5 - Evaluate and report performance of digital circuits.
CO6 - Design and Test elementary digital combinational-logic and sequential-logic circuits.

TEXT/REFERENCE BOOKS

- M. Morris Mano and Michael Ciletti, “Digital Design: With a Introduction to the Verilog HDL”, 5th edition,Pearson.

<Course Code>					Data Structures and Algorithms					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To impart the basic concepts of data structures and algorithms
2. To explain different types of data structures such as stacks, queues, lists, trees and graphs
3. To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures

UNIT I: INTRODUCTION TO DATA STRUCTURE	**12 Hrs.**
Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off Searching: Linear Search and Binary Search Techniques and their complexity analysis. Stacks and Queues, Applications of Stacks: Expression Conversion and evaluation corresponding algorithms and complexity analysis.	
UNIT II: LINEAR DATA STRUCTURE	**10 Hrs.**
Fourier Transform: Integral transform, Fourier integral theorem, Fourier sine and cosine integrals, Fourier transforms, Fourier sine and cosine transforms, Properties of Fourier transform, Convolution, Parseval's identity, Relationship between Fourier and Laplace transform.	
UNIT III: NON-LINEAR DATA STRUCTURE	**10 Hrs.**
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	
UNIT IV: SORTING AND SEARCHING AND HASHING	**10 Hrs.**
Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Define the basic concepts of data structures to represent data items in real world.
CO2	:	Understand the concepts of algorithm evaluation and find time and space complexities.
CO3	:	Apply the linear data structure, such as stacks, queues, and linked lists, for various applications.
CO4	:	Analyse the basic operations on binary trees.
CO5	:	Evaluate traversal techniques of graphs for certain applications.
CO6	:	Design and develop the application of algorithms for sorting and pattern matching.

TEXT/REFERENCE BOOKS

1. Jean-Paul Tremblay & Paul G "**An Introduction to Data Structures with Applications**", Tata McGraw Hill.
2. Ten Baum "**Data Structures using C & C++**", Prenctice-Hall International.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein "**Introduction to Algorithms**", Third Edition, PHI Learning.
4. Sanjoy DasGupta, C. H. Papadimitriou, Umesh Vazirani "**Algorithms**", First Edition, Tata McGraw Hill, 2006. Data Structures:
5. E.Horowitz, S.Sahni and Susan AndersonFreed "**Fundamentals of Data structures in C**", 2nd Edition, Universities Press

<Course Code>					Data Structures and Algorithms Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To implement linear and non-linear data structures.
2. To understand the different operations of search trees.
3. To implement graph traversal algorithms.
4. To get familiarized to sorting and searching algorithms.

LIST OF EXPERIMENTS	
1	Write a C program to perform matrix multiplication using array.
2	(a) Write a C program to create a stack using an array and perform: (i) push operation (ii) pop operation (b) Write a C program to create a queue and perform: i) Push ii) pop iii) Traversal
3	Write a C program that uses Stack operations to perform the following: i) Converting infix expression into postfix expression ii) Evaluating the postfix expression
4	Write a C program that uses functions to perform the following operations on a Single linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal in both ways
5	Write a C program that uses functions to perform the following operations on Double linked list: i) Creation ii) Insertion iii) Deletion
6	Write a C program that uses functions to perform the following operations on Binary Tree: i) Creation ii) Insertion iii) Deletion
7	Write C programs that use both recursive and nonrecursive functions to perform the Linear search operation.
8	Write C program that use both recursive and non-recursive functions to perform the Binary search operation.
9	Write a C program that implement Bubble Sort method to sort a given list of integers in descending order.
10	Write a C program that implement Quick Sort method to sort a given list of integers in ascending order.

COURSE OUTCOMES

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

CO1	:	Understand the appropriate data structures as applied to the specified problem definition.
CO2	:	Apply operations like searching, insertion, and deletion, traversing mechanism, etc. on various data structures.
CO3	:	Analyze Linear and Non-Linear data structures.
CO4	:	Evaluate the appropriate sorting/searching technique for the problem.
CO5	:	Design advanced data structure using Non-linear data structure.
CO6	:	Determine and analyze the complexity of given Algorithms.

TEXT/REFERENCE BOOKS

1. Kruse, Tondo and Leung, "**Data Structures and Program Design in C**", 2nd edition, PrenticeHall,1997.
2. Ellis Horowitz, SartajSahni, "**Fundamentals of Data Structures**", Illustrated Edition by Computer Science Press.

24ICxxxT					Fundamentals of ICT					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- Provide students with a comprehensive understanding of the evolution, trends, and components of Information and Communication Technology (ICT).
- Equip students with the necessary skills to effectively manage and evaluate digital information, including information retrieval strategies, digital literacy principles, and data management techniques.
- Familiarize students with modern technologies shaping the future of ICT, such as Artificial Intelligence/Machine Learning, Blockchain Technology, and IoT, and explore their applications across different domains.

UNIT 1: Introduction to ICT	**06 Hrs.**
Overview of ICT: Evolution and Trends in ICT, ICT Infrastructure and Components, Role of ICT in Modern Society, and Industry; Type of ICT Services: Software Development, Computer Networking, Telecommunication, Cybersecurity, Data Analytics, Cloud Computing	
UNIT 2: ICT Technologies	**09 Hrs.**
Hardware Technologies: Data Processing Hardware, Data Input Hardware, Data Output Hardware, Data Transmission Hardware, Data Storage Hardware; Software Technologies: Firmware, Operating Systems, IT Protocols, Programming Languages, Software Development Methodologies; Communication Technologies	
UNIT 3: Information Management and Digital Literacy	**08 Hrs.**
Managing and evaluating digital information, Information retrieval strategies, digital literacy topics such as copyright and plagiarism, data management techniques, and information security practices. digital ethics and security, data management, Modern Technologies for ICT using Artificial Intelligence/Machine Learning, Blockchain Technology, IoT.	
UNIT 4: Emerging Trends in ICT	**05 Hrs.**
Current and future trends in ICT, Application in different domains, futuristic tools and technologies for ICT advancements.	

Total: 28 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Identify various ICT components, and list types of ICT services.

CO2: Demonstrate comprehension of hardware/software technologies, communication technologies, and digital information management principles.

CO3: Apply information retrieval strategies, digital literacy principles, and data management techniques in practical scenarios.

CO4: Analyze the role of modern technologies such as AI/ML, Blockchain Technology, and IoT in ICT.

CO5: Evaluate current and future trends in ICT and assess their applications in different domains

CO6: Design ideas and proposals for futuristic tools and technologies to advance ICT.

TEXT/REFERENCE BOOKS

1. Rajaraman, V. Introduction to information technology. PHI Learning Pvt. Ltd., 2018.
2. Bryant, Randal E., and David Richard O'Hallaron. Computer systems: a programmer's perspective. Prentice Hall, 2011.
3. Schwab, Klaus. The fourth industrial revolution. Crown Currency, 2017.

<Course Code>					Electronic Devices and Circuits					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To study the basic principles, configurations and applications of electronic devices
2. To analyze and design transistor amplifiers and practical OPAMP based circuits
3. To understand the operation of D/A & A/D converter types and applications.

UNIT I: SEMICONDUCTOR DIODES AND CIRCUITS	**6 Hrs.**
Review of semiconductor basics, P-N Junction diodes, biasing, reverse saturation current, cut-in voltage, V-I Characteristics. Diode Applications: rectification, half-wave, full-wave and bridge rectifier and design, filters, clippers, clampers. Zener Diodes: voltage regulator, regulator design, varactor diodes, photo diodes, Schottky diodes, tunnel diodes and LEDs.	
UNIT II: Transistor Amplifiers	**8 Hrs.**
Transistors BJT, FET, MOSFET, types, working principal, characteristics, and region of operation, load line analysis, biasing techniques. Transistor as an amplifier, design of a single stage amplifier, gain, bandwidth and frequency response. Frequency response of multistage amplifiers.	
UNIT III: LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	**10Hrs.**
Basic op-amp circuits: Inverting & Non-inverting voltage amplifiers, Voltage follower, Summing, scaling & averaging amplifiers. Linear Applications: Instrumentation Amplifiers, V-I & I-V converters, Differentiators & Integrators, Active filters Non-linear Applications: Precision Rectifiers, Wave Shaping Circuits, Log and Antilog Amplifiers, Comparators and its applications, Sample and Hold circuits. Waveform Generators: Sine, Square and Triangular Wave generators. IC 555 Timer: Monostable operation and its applications – Astable operation and its application	
UNIT IV:	**4 Hrs.**
DAC Specifications: DAC circuits, Weighted Resistor DAC, R-2R Ladder, Monolithic DAC ADC specifications: ADC circuits, Flash Type, Ramp Type, Successive Approximation and Dual Slope ADC, Monolithic ADC.	
TOTAL HOURS: 28 Hrs.	

COURSE OUTCOMES

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

CO1	:	Remember the fundamentals of semiconductor devices
CO2	:	Understand the operation of semiconductor diodes, transistors and operational amplifier
CO3	:	Demonstrate the applications of operational amplifiers
CO4	:	Analyze the ADC and DAC using operational amplifiers
CO5	:	Evaluate performance of transistor circuits and Linear integrated circuits
CO6	:	Design diode rectifiers, voltage regulators, transistor amplifier and linear and nonlinear application of opamp

TEXT/REFERENCE BOOKS:

1. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Eleventh Edition, Pearson India Education, 2015.
2. Sedra, Smith and Chandorkar, “Microelectronic Circuits – Theory and Applications”, Seventh Edition, Oxford University Press, 2017.
3. Donald A Neamen, “Electronic Circuits – Analysis and Design”, Third Edition, McGraw Hill Education, 2006.
4. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, 4th Edition, Prentice Hall, 2000.
5. Roy Choudhury and Shail Jain, “Linear Integrated Circuits”, 2nd Edition, New Age International Publishers, 2003
6. Sergio Franco, “Design with operational amplifier and analog integrated circuits”, McGraw Hill, 1997

4th Semester

<Course Code>					< Database Management Systems >					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To learn the fundamentals of data models and to conceptualize and depict a database system using an ER diagram.
2. To make a study of SQL and relational database design.
3. To understand the internal storage structures which will help in physical DB design.
4. To know the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure.

UNIT I: CONCEPTUAL MODELING INTRODUCTION	**12 Hrs.**
Introduction - General introduction to database systems; Database - DBMS distinction, approaches to building a database, data models, database management system, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS.E/R Model - Conceptual data modeling - motivation, entities, entity types, various types of attributes, relationships, relationship types, E/R diagram notation, examples. Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity, and foreign keys. Converting the database specification in E/R notation to the relational schema.	
UNIT II: RELATIONAL APPROACH and SQL QUERY - BASICS	10 Hrs.
Relational algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus, Introduction to SQL, Data Definition of SQL, Basic structure of SQL queries, Basic SQL operations (rename, string operations, order by, where clause), Set operations, Null values, Aggregate functions, Nested Subqueries, Modification of Database, JOIN expressions, Views, Integrity constraints, Data types and Schemas, Authorization.	
UNIT III: RELATIONAL DATABASE DESIGN	10 Hrs.
Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF	
UNIT IV: TRANSACTION MANAGEMENT AND CONCURRENCY	10 Hrs.
Transaction processing: Transaction concept, transaction State, implementation of atomicity and durability, concurrent executions, serializability, recoverability. Concurrency Control: Lock-based protocols, timestamp-based protocols, validation-based protocols, multiple granularity, multiversion schemes, deadlock handling. Recovery: Failure classification, storage structure, recovery and atomicity, Log-Based recovery, shadow paging,recovery with concurrent transactions buffer management.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Understand the data models, schemas, instances, view levels and database architecture for voluminous data storage
CO2	:	Remember the concept of Relational Algebra and Relational Calculus from set theory to represent queries
CO3	:	Apply the concepts of SQL queries for data aggregation, calculations, views, sub-queries, embedded queries manipulation
CO4	:	Illustrate the definition of Functional Dependencies, Inference rules, and minimal sets of FD's to maintain data integrity.
CO5	:	Design the concepts of transaction, states, and ACID properties in data manipulation.
CO6	:	Design Build a database management system that satisfies relational theory and provides users with business queries.

TEXT/REFERENCE BOOKS

1. Silberschatz, Henry F. Korth, and S. Sudharshan, **"Database System Concepts"**, 7th Ed, Tata McGraw Hill.
2. J. Date, A. Kannan and S. Swamynathan, **"An Introduction to Database Systems"**, 8thed, Pearson Education
3. RamezElmasri and Shamkant B. Navathe, **"Fundamentals of Database Systems",** 7thEdition, Pearson/Addison-Wesley.

<Course Code>	< Database Management Systems Laboratory>
Teaching Scheme	Examination Scheme

L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. The SQL commands for data definition, manipulation, control and perform transactions in database systems.
2. The procedural language for implementation of functions, procedures, cursors and triggers using PL/SQL programs.
3. The logical design of a real time database system with the help of Entity Relationship diagrams.

LIST OF EXPERIMENTS	
1	Exercises on Installation and Accessing Database
2	Exercises on database definition language queries
3	Exercises on database Manipulation Language Queries.
4	Exercises on both DDL and DML Queries.
5	Exercises on tables with different types of constraints.
6	Exercises on Join Operations and Aggregate Functions in the Database.
7	Exercises on TCL (transaction control language) Queries to perform rollbacking and save point mechanisms.
8	Exercises on user accounts to grant privileges using Data Control language process.
9	Working with basic PL/SQL programming Examples
10	Working with PL/SQL Programming Functions

COURSE OUTCOMES

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

CO1	:	Demonstrate database creation and manipulation concepts with the help of SQL queries.
CO2	:	Make use of inbuilt functions of SQL queries to perform data aggregations, subqueries, embedded queries and views
CO3	:	Apply key constraints on database for maintaining integrity and quality of data
CO4	:	Demonstrate normalization techniques by using referential key constraints.
CO5	:	Implement PL/SQL programs on procedures, cursors and triggers for enhancing the features of database system to handle exceptions.
CO6	:	Design database model with the help of Entity Relationship diagrams for a real time system or scenario.

TEXT/REFERENCE BOOKS

1. Silberschatz, Henry F. Korth, and S. Sudharshan, “Database System Concepts”, 7th Ed, Tata McGraw Hill.
2. J. Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, 8thed, Pearson Education
3. RamezElmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, 7thEdition, Pearson/Addison-Wesley.

<Course Code>					< Principles of Programming Languages >					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

4. To learn about various constructs and their respective comparisons in different high-level languages.
5. To understand the salient features in the landscape of programming languages.
6. To understand design concepts for programming languages
7. To study various programming paradigms.

UNIT I: INTRODUCTION TO LANGUAGE DESIGN CONCEPTS	**10 Hrs.**
Reasons for studying concepts of programming languages, programming domains, language evaluation criteria, influences on language design, language categories, language design trade-offs, implementation methods, programming environments, Programming language design, programming language processing. Data types: primitive data types, composite data types, recursive data types, implementation and storage representation of data types. Type binding, binding and binding times, type checking, type conversion, expressions, statements.	
UNIT II: OBJECT-ORIENTED PROGRAMMING CONCEPTS	**10 Hrs.**
Need of object-oriented paradigm, basic concepts of object-oriented programming (OOP), benefits of OOP. General characteristics for OOP, concepts - object, classes, messages, methods. Class Identification, object oriented as abstract data type. Data abstraction, encapsulation, polymorphism, inheritance, dynamic binding, abstract classes, interfaces, generic class, run time type identification. Dynamic Memory Management, Exception Handling	
UNIT III: PROCEDURAL PROGRAMMING	**10 Hrs.**
Introduction to procedures, parameter passing methods, lifetime of variables, scope rules: static and dynamic scope, nested scope, procedure call and return, recursive sub-program. Referencing environment, activation records, storage management, desirable and undesirable characteristics of procedural programming.	
UNIT IV: FUNCTIONAL PROGRAMMING	**10 Hrs.**
Introduction to functional programming, lambda calculus, ambiguity, free and bound identifiers, reductions, typed lambda calculus, application of functional programming. Functional Programming with python, elements of functional Programming, function declaration, expression evaluation, type checking.	
TOTAL HOURS: 40 Hrs.	

COURSE OUTCOMES

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

CO1	:	Identify fundamental concepts, terminologies, and syntax of various programming languages.
CO2	:	Understand the differences between various programming paradigms such as procedural, object-oriented, functional, and logical programming.
CO3	:	Apply the concepts programming languages to solve specific computational problems, applying appropriate syntax and constructs.
CO4	:	Analyze the impact of language design choices on program efficiency, maintainability, and scalability
CO5	:	Evaluate the suitability of different programming languages for specific application domains and development environments.
CO6	:	Design innovative solutions to complex problems using advanced language features and programming paradigms.

TEXT/REFERENCE BOOKS

1. S Roosta, "**Foundations of Programming Languages"**, Thomson, Brooke/Cole, (India Edition)
2. R Sethi, **"Programming Languages concepts & constructs",** Pearson Education, (2nd Edition)
3. R Sebesta, **"Concepts Of Programming Languages",** Pearson Education, (10th Edition)
4. Allen Tucker, Robert Noonan, "**Programming Languages: Principles and Paradigms",** Tata McGraw Hill, (2nd edition)

<Course Code>					< Principles of Programming Languages Laboratory>					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To introduce the various programming paradigms.
2. To understand the evolution of programming languages.
3. To understand the concepts of OO languages, functional languages, logical and scripting languages.

LIST OF EXPERIMENTS	
1	To study the concepts of programming languages.
2	To study the programs to implement the concepts of classes and objects.
3	To design a program to Demonstrate the concept of constructor.
4	To design a program to demonstrate Single, multiple, multilevel, hybrid, hierarchical inheritance, and Virtual base classes
5	To design a program to demonstrate the concept of operator overloading
6	To design a program to Demonstrate the concept of dynamic memory management
7	To design a program to demonstrate the concept of Exception Handling
8	To design a program to demonstrate the concept of Generic Programming
9	To design a program to demonstrate the concept of functional programming
10	To design a program to demonstrate the concept of procedural programming

COURSE OUTCOMES -

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

CO1	:	Introduce notations to describe syntax, semantics of programming languages and language features used in current programming languages.
CO2	:	Understand the major programming paradigms, and the principles and techniques involved in design and implementation of modern programming languages
CO3	:	Analyze the concepts of ADT, Object Oriented Programming
CO4	:	Analyze and explain behavior of simple programs in imperative languages using concepts such as binding, scope, control structures, subprograms and parameter passing mechanisms.
CO5	:	Evaluate key concepts in the implementation of common features of programming languages.
CO6	:	Demonstrate Concurrency Control and Exception Handling for large-scale software development.

TEXT/REFERENCE BOOKS

1. S Roosta, "**Foundations of Programming Languages**", Thomson, Brooke/Cole, (India Edition)
2. R Sethi, "**Programming Languages concepts & constructs**", Pearson Education, (2nd Edition)
3. R Sebesta, "**Concepts Of Programming Languages**", Pearson Education, (10th Edition)

<Course Code>					Fundamentals of Signal Processing and Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

8. Introduce mathematical tools for analysis of continuous time signals and LTI systems.
9. Understand basic principles of communication systems.
10. Create foundation for digital signal processing.

UNIT I: CONTINUOUS TIME SIGNALS AND SYSTEMS	**10 Hrs.**
Signal – Definition, Examples, Classifications, Continuous time signals: Energy, power, periodicity, Signal operations, Elementary Signals, System - Definition, Classification, Continuous time LTI systems: Convolution integral and unit impulse response, Interconnections, stability and causality.	
UNIT II: FOURIER ANALYSIS AND CORRELATION OF SIGNALS	**13 Hrs.**
Trigonometric and Exponential Fourier series for Periodic Signals, Convergence and Truncation, Fourier transform, Signal spectra, Dirichlet conditions, Important Properties. Impulses in Frequency Domain and Fourier Transform of Periodic Signals, Frequency analysis of LTI systems, Signal distortions, Distortionless transmission, Ideal vs. practical filters, Parseval's relation, Essential bandwidth, Time correlation of signals, Spectral densities, Relation between convolution and time correlations.	
UNIT III: FUNDAMENTALS OF COMMUNICATION SYSTEMS	**11 Hrs.**
Baseband and carrier communication, AM Schemes: modulation and detection – DSBFC, DSBSC, SSB, VSB, QAM, Angle Modulation and Demodulation, Wideband and narrowband FM, Principles and working of super heterodyne receiver: sensitivity and selectivity, Noise types, Signal to noise ratio (SNR), Noise factor and Noise figure, Noise modeling, PSD of white noise and narrow band noise, Noise performance comparison of AM and FM schemes.	
UNIT IV: FOUNDATION FOR DIGITAL SIGNAL PROCESSING	**8 Hrs.**
Sampling and Sampling theorem, Reconstruction, Aliasing, Discrete time elementary signals, Discrete time LTI system and unit impulse (sample) response, Convolution sum, Linear constant co-efficient difference equation representation, Stability and causality, Discrete time vs. digital signal processing, Concept of quantization, A to D and D to A conversion, Future study directions.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Remember properties of signals, systems, and principles of various modulation and demodulation methods.
CO2	:	Understand mathematical representation of signals, systems, modulated signals and detection techniques.
CO3	:	Apply mathematical concepts to model behavior of LTI systems, modulation and demodulation of signals.
CO4	:	Analyze signals and systems in time and frequency domain to obtain various parameters.
CO5	:	Evaluate properties of LTI systems and performance of communication systems.
CO6	:	Design a block diagram level elementary communication and signal processing system.

TEXT/REFERENCE BOOKS

(1) Alan V.Oppenheim, Alan S.Willsky with S. Hamid Nawab, Signals & Systems, Pearson Education.
(2) B. P. Lathi, Signal Processing and Linear System, Berkeley Cambridge Press.
(3) B.P.Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press.
(4) P. Chakrabarti, Analog and Digital Communication, Dhanpat Rai & Co.
(5) J. G.Proakis, D. G.Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, PHI.

24ICxxxT					Computer Organization and Microprocessor					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand design aspects of basic computer systems
- To explore the advanced features for throughput improvement
- To apply concepts in microprocessor system development
- To make basis for operating systems by understanding the concepts of memory management.

UNIT 1: Basic Computer Organization	**11Hrs.**
Introduction to FSM, Moore and Mealy machines. Basic architecture of micro-computer and Central processing unit, concept of data, address and control bus, register transfer language, Stored program organization, instruction format, common bus system, instruction set completeness, timing and control, instruction cycle, types of instructions, design of Basic central processing unit. Hardwired and microprogramed control Units, Interrupts in basic computer.	
UNIT 2: Advanced features of computer system	**10 Hrs.**
Flynn's classification of computer systems, Parallel processing, pipelining, vector processing, arithmetic and instruction pipeline. Memory organization, cache and virtual memory management.	
UNIT 3 : 8086 Microprocessor	**11 Hrs.**
Evolution of microprocessor, Pin diagram, signals, and register set of 8086. Addressing modes, instruction set, assembly language programming, Counters and Time delays, Stack, subroutine, Restart, Conditional Call and Return Instructions, interrupts of 8086.	
UNIT 4 : Interfacing using 8085	**10 Hrs.**
Address decoding techniques, interfacing concepts, IO mapped IO, Memory mapped IO, interfacing of basic devices, interfacing PPI 8255, and Interrupt controller 8259.	

Total: 42Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Recall and describe the basic components of computer architecture, including the CPU, memory, and I/O devices, and understand their respective functions and interactions within a computer system.

CO2: Demonstrate the understanding of basic computer design, architecture and functionalities of the 8085 microprocessor, including its instruction set, addressing modes, and interfacing with peripherals.

CO3: Practice and debug assembly language programs for the 8085 microprocessor to perform specific tasks, demonstrating their ability to apply the knowledge of microprocessor architecture in practical programming scenarios.

CO4: Apprise the concept of programming, including data types, control structures, functions, and algorithms, and will be able to analyze and explain the functionality of different programming constructs

CO5: Evaluate the advanced architectural features and innovations in modern CPUs, such as pipelining, caching, multi-core processing, and parallel computing, and understand their impact on performance and efficiency.

CO6: Integrate and apply their knowledge of basic computer architecture design, 8085 microprocessor architecture, programming, and advanced CPU features to design, develop, and optimize a basic computer system or program, demonstrating their ability to create and innovate in the field of computer architecture and design.

TEXT/REFERENCE BOOKS

1. Morris M. Mano, "Computer System Architecture", Pearson Education, 3rd edition, 2017.
2. John P. Hayes, "Computer Architecture and Organization", McGraw Hill Education, 3rd edition, 1998.
3. William Stallings, "Computer Organization & Architecture", Pearson Education, 11th Edition, 2022.
4. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with 8085", Penran International, 6th edition, 2013.
5. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah, "Microprocessors and Interfacing", Oxford University Press, 2012.
6. Douglas Hall, "Microprocessor and Interfacing", Mcgraw Hill Higher Education, 2005.

24ICTxxxP	Computer Organization and Microprocessor Lab

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES:

- To understand design aspects of basic computer systems through simulation
- To apply concepts in microprocessor system development
- To do assembly language programming using 8085 instruction set to complete different tasks.

List of Experiments: Following is the list of experiments but it is not limited to:

1. To design a FSM with given sequence
2. To design and demonstrate the working of a massage on 7-segmnet display.
3. To design register with synchronous control inputs like clear, load and increment and with provision to handle different no of bit than common bus.
4. To design common bus systems using multiplexure
5. To design ALU with given specification
6. To design control unit for given CPU specification
7. To Write an assembly language code to implement data transfer instruction.
8. To write an assembly language code to store numbers in reverse order in memory location.
9. To write an assembly language code to implement arithmetic instruction.
10. To write an assembly language code to implement logical instruction set to carry out a task.
11. To write an assembly language code to implement the subroutine call.
12. To write an assembly language code to implement RIM and SIM to interface a peripheral.

*** Some of these experiments need to be using simulation software.**

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Recall and describe the basic components of computer architecture, including the CPU, memory, and I/O devices, and understand their respective functions and interactions within a computer system.

CO2: Demonstrate the understanding of basic computer design, architecture and functionalities of the 8085 microprocessor, including its instruction set, addressing modes, and interfacing with peripherals.

CO3: Practice and debug assembly language programs for the 8085 microprocessor to perform specific tasks, demonstrating their ability to apply the knowledge of microprocessor architecture in practical programming scenarios.

CO4: Apprise the concept of programming, including data types, control structures, functions, and algorithms, and will be able to analyze and explain the functionality of different programming constructs

CO5: Evaluate the advanced architectural features and innovations in modern CPUs, such as pipelining, caching, multi-core processing, and parallel computing, and understand their impact on performance and efficiency.

CO6: Integrate and apply their knowledge of basic computer architecture design, 8085 microprocessor architecture, programming, and advanced CPU features to design, develop, and optimize a basic computer system or program, demonstrating their ability to create and innovate in the field of computer architecture and design.

TEXT/REFERENCE BOOKS

1. Morris M. Mano, “Computer System Architecture”, Pearson Education, 3rd edition, 2017.
2. John P. Hayes, “Computer Architecture and Organization”, McGraw Hill Education, 3rd edition, 1998.
3. William Stallings, “Computer Organization & Architecture”, Pearson Education, 11th Edition, 2022.
4. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with 8085”, Penran International, 6th edition, 2013.
5. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah, “Microprocessors and Interfacing”, Oxford University Press, 2012.
6. Douglas Hall, “Microprocessor and Interfacing”, Mcgraw Hill Higher Education, 2005.

5th Semester

<Course Code>					Theory of Computation and Compiler Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Provides the required theoretical foundation for a computational model and compiler design
2. Discuss various types of machines as an abstract computational model
3. Study and design various methods to develop different phases of compiler

UNIT 1 LANGUAGES, GRAMMARS AND AUTOMATA	**12 Hrs.**
Fundamentals of formal languages, grammars, and computation models, Introduction to compilers and its Phases, Finite Automata, Regular Language and Regular Expressions, Deterministic and Non-deterministic Finite Automata, Minimization of DFA, Conversion of RE to DFA using Arden's Formula, Pumping Lemma, Design Lexical Analyser using Finite Automata	
UNIT 2 CFG, CFL, PDA, and PARSERS	**12 Hrs.**
Push Down Automata (PDA), Deterministic and Non-deterministic PDA, Context Free Grammar (CFG), Left Most Derivation, Right Most Derivation, Parse Tress, Ambiguity in languages, Normal Forms, Context Free Language (CFL), Pumping Lemma for CFL, CYK membership algorithms, Syntax analysis, Top-Down parsing, Bottom-Up parsing, Operator-Precedence parsing	
UNIT 3 TURING MACHINES AND INTERMEDIATE CODE GENERATION PHASE	**9 Hrs.**
Turing Machines, Recursive and recursively enumerable languages, Chomsky's hierarchy, Halting problem, Universal Turing Machine, The Classes P and NP, An NP-complete problem, Intermediate Code Generation, Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, etc.	
UNIT 4 CODE OPTIMIZATION AND CODE GENERATION	**9 Hrs.**
Code optimization phase of the compiler, Basic blocks and flow graphs, The DAG representation, The principal sources of optimization, code optimization techniques, Code generation techniques, Issues in the design of a code generator	

Max. 42 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1	:	Remember the concepts of formal languages, grammar and automata
CO2	:	Comprehend various computational models
CO3	:	Apply the knowledge of theory of computation and automata to study phases of compilers.
CO4	:	Analyse the different types of parsers.
CO5	:	Evaluate different compiler design techniques
CO6	:	Design all the seven phases of compiler for a specific language

TEXT/REFERENCE BOOKS

1. Introduction to Automata Theory, Languages, and Computation (3rd Edition), John E Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson Education, 2013.
2. Compilers: Principles, Techniques, and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, 2nd Edition, Pearson Education

<Course Code>					Theory of Computation and Compiler Design Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

1. Provides the required theoretical foundation for a computational model and compiler design
2. Discuss various types of machines as an abstract computational model
3. Study and design various methods to develop different phases of compiler

The lab experiment could be based on following topics:

1. Understanding concepts of Language, Alphabet, Operation on Language
2. Design and write a program for DFA
3. Study of DFA, NDF and conversions
4. Minimization of DFA
5. Study different phases of compiler and design Lexical analyser by token passing
6. Understanding CFG and CFL
7. Designing the PDA
8. Designing the Top-down parser
9. Designing the Bottom-up parser
10. Study and design of Turing Machine
11. Study of code synthesis phases of compiler

COURSE OUTCOMES

On completion of the course, students will be able to

CO1	:	Remember the concepts of formal languages, grammar and automata
CO2	:	Comprehend various computational models
CO3	:	Apply the knowledge of theory of computation and automata to study phases of compilers.
CO4	:	Analyse the different types of parsers.
CO5	:	Evaluate different compiler design techniques
CO6	:	Design all the seven phases of compiler for a specific language

TEXT/REFERENCE BOOKS

1. Introduction to Automata Theory, Languages, and Computation (3rd Edition), John E Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson Education, 2013.
2. Compilers: Principles, Techniques, and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, 2nd Edition, Pearson Education

24ICxxxT					Digital Signal Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Introduce mathematical tools for analysis of continuous time signals and LTI systems.
- Understand basic principles of communication systems.
- Create foundation for digital signal processing.

UNIT 1: ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS	10 Hrs.
Introduction to DSP, A review of Sampling Theorem, Discrete Time Signals and Systems, Z-transform, ROC and Properties, Poles- Zeros, Inverse z-transform, LTI System Analysis using Z-transform, Discrete Time Fourier Transform (DTFT) and Important Properties, Frequency Response of Discrete Time Systems, Correlation of Discrete Time Signals, Parseval's relation, Energy and Power Spectral Density.	
UNIT 2: DIGITAL FILTERS: DESIGN AND STRUCTURES	**11 Hrs.**
Ideal Digital Filters, Practical Filters: Stability and Causality, FIR and IIR Filters, Linear Phase and Implications, Filter Design Steps, Design of Linear Phase FIR Filters, Window Method, IIR Filter Design, Pole-Zero Placement Method, Analog Filter Design, Analog Filter Standard Frequency Responses and Design Equations, IIR Filter Coefficients from Analog Filter, Bilinear Transformation, Basic Structures for FIR and IIR Systems implementation, Direct, Transposed Cascade and Parallel form Structures, Effects of Co-efficient Quantization.	
UNIT 3: DFT AND FFT ALGORITHMS	**11 Hrs.**
Effect of periodicity and discretization on spectra of a signal, Sampling of DTFT, DFT and IDFT, Important Properties of DFT, Linear and Circular Convolution, Efficient Computation of DFT, Radix2 FFT Algorithms, Geortzel Algorithm.	
UNIT 4: FOURIER ANALYSIS OF SIGNAL AND SYSTEM USING DFT AND HILBERT TRANSFORM	**10 Hrs.**
DFT Analysis of Sinusoidal Signals; The Time-Dependent Fourier Transform; Block Convolution using the Time Dependent Fourier Transform; Application of DFT in Linear Filtering, Fourier Analysis of Nonstationary Signals; Fourier Analysis of Stationary Random Signals: The Periodogram, Fourier Transform for Causal Sequences; Relationships between Magnitude and Phase; Hilbert Transform Relations for Complex Sequences	

Total: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Remember properties of signals, systems, and principles of various modulation and demodulation methods.
CO2: Understand mathematical representation of signals, systems, modulated signals and detection techniques.
CO3: Apply mathematical concepts to model behavior of LTI systems, modulation and demodulation of signals.
CO4: Analyze signals and systems in time and frequency domain to obtain various parameters.
CO5: Evaluate properties of LTI systems and performance of communication systems.
CO6: Design a block diagram level elementary communication and signal processing system

TEXT/REFERENCE BOOKS

4. Alan V.Oppenheim, Alan S.Willsky with S. Hamid Nawab, Signals & Systems, Pearson Education.
5. B. P. Lathi, Signal Processing and Linear System, Berkeley Cambridge Press.
6. B.P.Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press.
7. P. Chakrabarti, Analog and Digital Communication, Dhanpat Rai & Co.
8. J. G.Proakis, D. G.Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, PHI.

24ICxxxP					Digital Signal Processing Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To impart knowledge of flow process of digital signal processing.
- To implement digital signal processing algorithms on software platforms.
- To evaluate performance of digital signal processing systems and algorithms

Laboratory Sessions would be based on following topics but not limited to:

1. Discrete time signal generation and applying different operations on signals.
2. Z-domain and frequency domain analysis of discrete time signals and systems.
3. Design and implementations of FIR and IIR filters.
4. Implementation and application of DFT-FFT in linear filtering.
5. Simulation of discrete time systems for speech and audio applications.
6. Implementation of digital signal processing algorithm.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Remember representation of discrete time signals and systems in Z-domain and frequency domain.
CO2: Understand the methodologies to utilize digital signal processing techniques practically.
CO3: Apply concepts to realize discrete time systems and digital signal processing algorithms practically.
CO4: Analyze and report the behaviour of discrete time systems and digital signal processing algorithms.
CO5: Evaluate and report performance of discrete time systems and digital signal processing algorithms.
CO6: Design and implement practical applications using software development tools.

TEXT/REFERENCE BOOKS

1. 1.Alan V.Oppenheim, Alan S.Willsky with S. Hamid Nawab, Signals & Systems, Pearson Education.
2. B. P. Lathi, Signal Processing and Linear System, Berkeley Cambridge Press.
3. B.P.Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press.
4. P. Chakrabarti, Analog and Digital Communication, Dhanpat Rai & Co.
5. J. G.Proakis, D. G.Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, PHI.

24ICxxxT					RF Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To Impart electromagnetic and transmission line concepts
- To learn the radiating body behavior for wireless communication system
- To introduce the wave propagation mechanism in different modes
- To elaborate and familiarize the different modern RF technologies

UNIT Electromagnetics:	**17Hrs.**
Maxwell's equations, pointing theorem, uniform plane wave and reflection, plane wave propagation in free space and lossless & lossy media. Transmission line: Types of transmission lines, transmission line equation and solution, reflection and transmission coefficients, standing wave and standing wave ratio, line impedance, Smith chart, impedance matching. Waveguides, waveguide Tees, bands, corners, twists, posts, irises, directional couplers, Faraday's rotation, circulator and isolator, Introduction, modes (TEM, TEmn, TMmn) and field pattern in medium, S-parameters.	
UNIT 2: RADIATING SYSTEMS	**10 Hrs.**
Basics: Radiation Mechanism and Current Distribution, Fundamental Parameters related to antenna (Radiation Pattern, Radiation Power Density, Directivity, Gain, Beam width, Bandwidth, Polarization, Radiation Efficiency, Antenna Efficiency, Far Field Radiation. Antenna Array: Two Element Array N-Element Linear Array with uniform amplitude and spacing, Broadside and End-Fire Arrays, N-Element 2D Array. Microstrip antenna: Introduction to strip line and microstrip lines, Advantages and limitations, feeding techniques, introduction to rectangular microstrip antenna, RMSA and CMSA design, filters design using microstrip line.	
UNIT 3 : RADAR AND WAVE PROPAGATION	**8 Hrs.**
Introduction (basic principle and types) to radar, radar range equation, maximum unambiguous range, pulse & MTI radars blind speed, radar resolution. Modes of wave propagation, Ground Wave Propagation, Sky wave propagation, Definitions for Virtual height, MUF and Skip distance, Multi-hop propagation, Space wave propagation..	
UNIT 4 : MODERN RF TECHNOLOGIES	**7 Hrs.**
RFID, NFC technology and their interfacing with IoT, RF Energy harvesting for WSN & IoT, 5G Technology, Antenna Design for 5G, MU-MIMO and Massive MIMO for5G Radios, study of effect of RF on flora fauna and human being.	

Total: 42Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Remembering the fundamentals of electromagnetics, radiating structures, wave propagation and modern RF techniques.

CO2: Understanding effect and outcome of RF waves propagating in different mediums including transmission line, free space and the under influence of RF Techniques.

CO3: Applying the concepts of transmission medium, radiating elements and wave propagation in developing new systems.

CO4: Analyzing the behaviour of wave and its impact on passive component properties in different transmission conditions

CO5: Evaluating different RF Technologies, components and mediums for RF Waves.

CO6: Design RF subsystems utilizing the radiating elements, passive components utilizing different mediums for developing different technologies.

TEXT/REFERENCE BOOKS

1. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson Education, 3rd edition, 2012.
2. C. A. Balanis, "Antenna theory: analysis and design", John Wiley and sons, 3rd Edition, 2005.
3. M. L. Skolnik, "Introduction to Radar Systems", Mc Graw Hill, 3rd edition, 2016.
4. K. D. Prasad, "Antenna and wave Propagation", Satya Prakashan, 3rdedition, 2009.

24ICTxxxP					RF Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES:

- To Impart electromagnetic and transmission line concepts
- To learn the radiating body behavior for wireless communication system
- To introduce the wave propagation mechanism in different modes

To elaborate and familiarize the different modern RF technologies

List of Experiments: Following is the list of experiments of experiments but it is not limited to it.

1. To measure position of fault in cable
2. To measure the frequency and wavelength using slotted line section and frequency meter.
3. To measure the Isolation and Insertion loss of Isolator and Circulator.
4. To study E-plane/H-plane/Magic Tee.
5. To measure Coupling Factor, Directivity and Isolation of directional coupler.
6. To measure VSWR and Reflection coefficient of different loads.
7. To study the characteristics of Klystron and Gunn diode.
8. To study the behavior of Transmission line: Waveguide/Coaxial cable/microstrip line.*
9. To study the S-parameter of directional coupler.*
10. To study the S-parameter of E-plane/H-plane Tee.*
11. To design and study MIC Based LPF.*

*** Some of these experiments need to be using simulation software.**

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Remembering the fundamentals of electromagnetics, radiating structures, wag=ve propagation and modern RF techniques.
CO2: Understanding effect and outcome of RF waves propagating in different mediums including transmission line, free space and the under influence of RF Techniques.
CO3: Applying the concepts of transmission medium, radiating elements and wave propagation in developing new systems.
CO4: Analyzing the behaviour of wave and its impact on passive component properties in different transmission conditions
CO5: Evaluating different RF Technologies, components and mediums for RF Waves.
CO6: Design RF subsystems utilizing the radiating elements, passive components utilizing different mediums for developing different technologies.

TEXT/REFERENCE BOOKS

9. Samuel Y. Liao, “Microwave Devices and Circuits”, Pearson Education, 3rd edition, 2012.
10. C. A. Balanis, “Antenna theory: analysis and design”, John Wiley and sons, 3rd Edition, 2005.
11. M. L. Skolnik, “Introduction to Radar Systems”, Mc Graw Hill, 3rd edition, 2016.
12. K. D. Prasad, “Antenna and wave Propagation”, Satya Prakashan, 3rdedition, 2009.

6th Semester

<20IC303T >					Digital Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To impart basic knowledge of digital modulation and demodulation techniques.
2. To Understand coding and multiple access principles
3. Understand the basic principles of wireless communication systems.

UNIT I: DIGITAL BASEBAND COMMUNICATION TECHNIQUES	**10 Hrs.**
Review of Analog and digital Messages, Low pass sampling, Aliasing, Interpolation, PAM, PPM and PWM, PCM: Quantization, Uniform and non-uniform quantization, Quantization noise, Companding laws, DPCM, DM ADM, and SDM, Time division multiplexing (TDM), Line coding, Pulse shaping, Digital receivers, Regenerative repeaters.	
UNIT II: CARRIER COMMUNICATION TECHNIQUES	**10 Hrs.**
Carrier Communication Techniques: ASK, FSK, PSK, QAM, DPSK, MSK, GMSK, M-ary, Coherent and non-coherent detection, Carrier synchronization, Frequency Division Multiplexing (FDM), Noise performance and comparison of digital communication systems.	
UNIT III: INFORMATION THEORY AND SOURCE CODING	**12 Hrs.**
Uncertainty and Information, Average Mutual Information and Entropy, Measure of Information, Source Coding Theorem, Huffman and Shanon-Fano Coding, Uniqueness Property, Channel Models, Channel Capacity, Error free Communication over a Noisy Channel, Information Capacity, Shannon Limit.	
UNIT IV: ERROR CONTROL CODING (CHANNEL CODING)	**10 Hrs.**
Selection of Channel Codes, Error Correcting Codes: Linear Block Codes, Hamming Distance, Perfect Codes and Hamming Codes, Cyclic Codes, Burst Error Correcting and Detecting Code, Introduction to CRC, BCH, Reed-Solomon, Convolution Codes.	
	Total: 42 Hrs.

COURSE OUTCOMES

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

CO1	:	Remember principles of various digital communication methods.
CO2	:	Understand digital modulation, detection, coding, digital transmission and access techniques.
CO3	:	Apply mathematical concepts to model digital communication system.
CO4	:	Analyze digital communication systems to obtain various parameters like bandwidth, data rate etc.
CO5	:	Evaluate and compare performance of digital communication systems.
CO6	:	Design a block diagram level simple digital communication system.

TEXT/REFERENCE BOOKS

1. B. P. Lathi, Zhi Ding “Modern Digital and Analog Communication Systems”, Oxford University Press.
2. P. Chakrabarti, “Analog and Digital Communication”, Dhanpat Rai & Co.
3. Wayne Tomasi “Electronic Communications Systems”, Pearson education India.
4. Ranjan Bose, “Information Theory, Coding and Cryptography”, PHI.
5. Simon Haykins & Michael Moher, Communication Systems, 5th Edition, John Willey, India Pvt. Ltd, 2010.
6. Simon Haykins & Michael Moher, An Introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2008.
7. T. Rappaport, “Wireless Communications – Principles and Practice”, Prentice Hall.

24IC***P					Digital Communication Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To impart knowledge of digital modulation, demodulation and coding techniques.
2. To verify performance of various baseband and carrier digital communication systems.
3. To compare various digital communication systems and understand their applications.

LIST OF EXPERIMENTS	
1	PAM, PPM, PWM baseband techniques
2	Sampling, Quantization, PCM and variants
3	Digital carrier communication (ASK, FSK, PSK etc.) techniques
4	TDM techniques and synchronization
5	QAM and FDM Techniques
6	Error detection and correction techniques
7	Noise and BER analysis in various digital communication systems
8	OFDM Techniques
9	Spread spectrum communication

COURSE OUTCOMES

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

CO1	:	Remember principles of various digital communication methods.
CO2	:	Understand digital modulation, detection, coding, digital transmission and multiplexing techniques.
CO3	:	Apply theoretical and mathematical concepts to practical digital communication system.
CO4	:	Analyze and report the characteristics of various modulation, demodulation, multiplexing, synchronization, coding techniques.
CO5	:	Evaluate and report performance of digital communication systems.
CO6	:	Design and implement small scale digital communication system using development tools.

TEXT/REFERENCE BOOKS

1. B.P.Lathi, Zhi Ding "**Modern Digital and Analog Communication Systems**", Oxford University Press.
2. P. Chakrabarti, "**Analog and Digital Communication**", Dhanpat Rai & Co.
3. Wayne Tomasi "Electronic Communications Systems", Pearson education India.
4. Ranjan Bose, "**Information Theory, Coding and Cryptography**", PHI.
5. T. Rappaport, "**Wireless Communications – Principles and Practice**",Prentice Hall.

24ICT***T					Computer Communication and Networking					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To learn the fundamentals of networking layers and protocols.
2. To be able to understand, analyze, and design computer communication systems.
3. To develop various networking algorithms for enhancing the efficiency of existing networking protocols.
4. To study real-life applications of different networking protocols.

UNIT I: PHYSICAL AND DATA LINK LAYERS	**12 Hrs.**
Introduction: Nuts and Bolts, Performance parameters: throughput, delay, etc., Layered Architecture (OSI and TCP/IP), Data link layer: Introduction, Media access protocols (ALOHA, CSMA based) , Ethernet 802.3, Token, ring 802.5, Reliability Issue: sliding window, Internetworking and Routing: Best effort Service, Virtual Circuits, IP Addressing, introduction to physical layer services, different types of modulation schemes, multiplexing and de-multiplexing techniques, parity, cyclic redundancy check.	
UNIT II: NETWORK LAYER	**12 Hrs.**
Internetworking and Routing: Routing Issues, Distance Vector and Link State routing, Intra and Inter Autonomous System Routing (OSPF, RIP, BGP), Broadcast and Multicast Routing Issues. Network layer data plane: Concept of data forwarding, Longest prefix matching, switching fabrics, packet scheduling, IP addressing: IPV4 and IPV6, concept of subnet, NAT.	
UNIT III: TRANSPORT LAYER	**10 Hrs.**
Transport Layer: End to end delivery issues, Reliable data transfers, Congestion Control, Traffic engineering and Quality of service, TCP, UDP, Advanced Topics: QoS over IP, IPV6, and Infrastructure-less networks: wireless ad hoc and sensor networks, and Internet of Things (IoT), Green computer networking.	
UNIT IV: APPLICATION LAYER	**8 Hrs.**
Network application Design, Socket Programming, Client-server applications, Echo and Chat applications, DHCP, HTTP, FTP, DNS, Peer to Peer file sharing application.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Remember concepts of protocol design at different network layers
CO2	:	Understand design and implementation of different networking protocols
CO3	:	Apply computer networking concepts to solve problems
CO4	:	Analyze computer networking protocols at different layers
CO5	:	Evaluate performance of different computer network protocols
CO6	:	Create computer networking applications

TEXT/REFERENCE BOOKS

1. James Kurose and Keith Rose, **"Computer Networking: A Top Down Approach",** Pearson Education
2. Larry L Peterson and Bruce S Davie, **"Computer Networks: A Systems Approach",** Elsevier
3. Andrew S Tanenbaum, **"Computer Networks",** Pearson Education
4. Behrouz A Forouzan, **"Data Communication and Networking",** McGraw Hill

24ICT***P					Computer Communication and Networking Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To learn the fundamentals of networking layers and protocols.
2. To be able to analyze and design computer communication systems.
3. To be able to implement various networking algorithms and analyze the performance using network simulators.

LIST OF EXPERIMENTS	
1	To study and prepare LAN cables (cross and straight), to configure LAN and perform Static Routing
2	Introduction to Socket Programming- Design and Implement client-server elements of a few network applications e.g. TCP/UDP client server, Echo client and server, Time client and server, Online Quiz and Buzzer Application, etc
3	Configure DHCP in a small LAN and understand its functionality using Wireshark/ Packet Tracer
4	Configure DNS in a small LAN and understand its functionality using Wireshark/ Packet Tracer
5	Understand functionality of HTTP using Wireshark/ Packet Tracer
6	Understand functionality of TCP and UDP using Wireshark/ Packet Tracer
7	Configure virtual LAN and understand its functionality using Wireshark/ Packet Tracer
8	Configure a wired network with Hosts, switches, hubs and routers using Packet Tracer
9	Configure a wireless LAN (Wi-Fi) using Packet Tracer.
10	Simulation of TCP/UDP connections and performance analysis
11	Simulation of a vehicular network using network simulator (NS3/NETSIM) and performance analysis
12	Simulation of 5G network using network simulator (NS3/NETSIM) and performance analysis

COURSE OUTCOMES

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

CO1	:	Remember concepts of functionality of layered network architecture.
CO2	:	Understand various types of network topologies, network devices and their functions within a network.
CO3	:	Apply computer networking concepts to solve problems.
CO4	:	Analyze computer networking scenarios using network simulator tools.
CO5	:	Evaluate different computer network protocols practically.
CO6	:	Create computer networking applications and scenarios.

TEXT/REFERENCE BOOKS

1. James Kurose and Keith Rose, **"Computer Networking: A Top Down Approach",** Pearson Education
2. Larry L Peterson and Bruce S Davie, **"Computer Networks: A Systems Approach",** Elsevier
3. Andrew S Tanenbaum, **"Computer Networks"**, Pearson Education
4. Behrouz A Forouzan, **"Data Communication and Networking",** McGraw Hill

7th Semester

<Course Code>					Software Engineering Methodologies					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing, and Maintenance phases.
2. To provide an idea of using various process models in the software industry according to given circumstances.
3. To gain knowledge of how Analysis, Design, Implementation, Testing, and Maintenance processes are conducted in a software project.

UNIT I: SOFTWARE PROCESS MODELS	**12 Hrs.**
Software Product, Software crisis, Handling complexity through Abstraction and Decomposition, Overview of software development activities, Process Models, Classical waterfall model, iterative waterfall model, prototyping mode, evolutionary model, spiral model, RAD model, V Model, Agile models: Extreme Programming, and Scrum. Requirement Gathering and Analysis, Functional and Non-functional requirements, Software Requirement Specification (SRS).	
UNIT II: STRUCTURED ANALYSIS & DESIGN	**10 Hrs.**
Overview of design process: High-level and detailed design, Cohesion and coupling, Modularity and layering, Function–oriented software design: Structured Analysis using DFD Structured Design using Structure Chart, Basic concepts of Object-Oriented Analysis & Design. User interface design, Command language, menu and iconic interfaces, UML.	
UNIT III: CODING AND SOFTWARE TESTING TECHNIQUES	**10 Hrs.**
Coding, Code Review, documentation. Testing: - Unit testing, Black-box Testing, Whitebox testing, Cyclomatic complexity measure, coverage analysis, mutation testing, Debugging techniques, Integration testing, System testing, Regression testing.	
UNIT IV: SOFTWARE RELIABILITY AND SOFTWARE MAINTENANCE	**10 Hrs.**
Basic concepts in software reliability, reliability measures, reliability growth modeling, Quality SEI CMM, Characteristics of software maintenance, software reverse engineering, software reengineering, and software reuse.	
	Total: 42 Hrs.

COURSE OUTCOMES

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

CO1	:	Understand and decompose the given project in various phases of a lifecycle.
CO2	:	Apply the appropriate process model depending on the user requirements.
CO3	:	Evaluate the various life cycle activities like Analysis, Design, Implementation, Testing, and Maintenance.
CO4	:	Analyze the various processes used in all the phases of the product
CO5	:	Design the knowledge, techniques, and skills in the development of a software product.
CO6	:	Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

TEXT/REFERENCE BOOKS

13. Roger S. Pressman "**Software Engineering, A Practitioner's Approach**", TMGHill.
14. I. Sommerville "**Software Engineering**",9th Ed., Pearson education.
15. Rajib Mall "**Fundamentals of Software Engineering**", PHI,2014.

<Course Code>					Software Engineering Methodologies Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

5. To explain the fundamental concepts of Software Engineering Lifecycle models.
6. To understand the software requirement specifications and the SRS documents.
7. To examine the various design and development solutions with proper analysis
8. To demonstrate the software project management skills through case studies.

LIST OF EXPERIMENTS	
1	To study how to define and develop of problem statement
2	To study the preparation of Software Requirement Specification Documents, Design Documents for Quiz System, Online Ticket Reservation System, and Course Registration System
3	To study the DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem (Use of a CASE tool required) Develop a structured design for the DFD model developed
4	To draw the Class Diagrams and show Various Class Relationships.
5	To draw the UML Component and Deployment Diagram for the identified System
6	To study the use cases and develop the Use case Model with include and external Relationships
7	To study the identified Scenarios find interaction between objects and represent using Sequence diagram
8	To study the identified Scenarios find interaction between objects and represent using Collaboration diagram
9	To draw the relevant Activity Diagram for the Same System
10	To draw the relevant State Chart diagram for the same System

COURSE OUTCOMES

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

CO1	:	Understand the basic concepts of Software Engineering.
CO2	:	Ability to translate end-user requirements into system and software requirements.
CO3	:	Analyze problems, and identify and define the computing requirements appropriate to its solution.
CO4	:	Evaluate various techniques, metrics, and strategies for Testing software projects.
CO5	:	Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.
CO6	:	Design different case studies on cost estimation of varying software models in a group as a team leader.

TEXT/REFERENCE BOOKS

16. Roger S. Pressman "**Software Engineering, A Practitioner's Approach**", TMGHill.
17. I. Sommerville "**Software Engineering**",9th Ed., Pearson education.
18. Rajib Mall "**Fundamentals of Software Engineering**", PHI,2014.

24ICxxxT					Embedded Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the foundational principles of embedded systems design and development.
- To acquire proficiency in programming microcontrollers and interfacing them with sensors, actuators, and other peripherals.
- To explore interfacing techniques for sensors, actuators, and other peripherals in embedded systems.
- To design and implement embedded systems solutions for real-world challenges through hands-on projects.

UNIT 1: EMBEDDED SYSTEMS – INTRODUCTION AND ARCHITECTURE	**11 Hrs.**
Introduction to embedded system (ES); Characteristics and functionalities; Classification of Embedded Systems; Microcontroller for Embedded Systems: microcontroller architecture, pin diagram and basic connections – clock, reset, brown-out, etc.; General register set; Special function registers; On-chip memories; General Purpose Inputs and Outputs (GPIOs)	
UNIT 2: ASSEMBLY PROGRAMMING FOR EMBEDDED SYSTEMS	**12 Hrs.**
Instruction Set and Assembly language programming: Data transfer, arithmetic, logic and branch instructions, addressing Modes; Basic programming concepts: Looping, branching, memory-access, time-delays, using assembly instructions; Stack and related operations; Subroutines and interrupts.	
UNIT 3: PERIPHERAL PROGRAMMING USING EMBEDDED C	**12 Hrs.**
Programming the on-chip modules/capabilities of the microcontroller using Embedded C: GPIOs, Timers/Counters, Waveform generation, EEPROM, ADC, Interrupt functionalities, Watchdog timer. Basics of parallel and serial communication; Programming the serial communication modules: USART, Serial Peripheral Interface (SPI), I2C Inter-integrated Circuit (I2C).	
UNIT 4: I/O INTERFACING IN EMBEDDED SYSTEM	**10 Hrs.**
Interfacing of I/O devices, LED and switches, 4x4 Keypad, 16x2 LCD, Motor drivers and opto-couplers, Stepper Motor, Servo Motor, DC Motors, Relays, Buzzers, Proximity sensor, temperature sensor, DAC, RTC. Interfacing wireless modules: Bluetooth, Wi-Fi, Zigbee.	

Total: 45 Hrs

COURSE OUTCOMES

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

CO1- Describe the basic components/functionalities, and architecture of microcontroller based embedded system.

CO2- Write simple programs using assembly language, and summarize the instruction set architecture for microcontroller.

CO3- Apply the syntax and constructs of the C language, to write Embedded C programs.

CO4- Analyze the functionality of on-chip modules/capabilities of the microcontroller: timers/counters, interrupts, basic communication protocols, EEPROM, ADC, waveform generator.

CO5- Comprehend and demonstrate the working of external input-output devices (interfacing of sensors and actuators) to the microcontroller.

CO6- Develop simple embedded system, utilizing Embedded C programming for interfacing input-output devices with the microcontroller and/or the related on-chip modules.

TEXT/REFERENCE BOOKS

1. Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi. “AVR Microcontroller and Embedded Systems: Using Assembly and C”, (2015), Pearson India.

2. Raj Kamal, “Embedded Systems: Architecture, Programming, and Design”, 2nd Edition, Tata McGraw-Hill.

3. Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design” – (second edition), Morgan Kaufmann

4. K.V. Shibu, “Introduction To Embedded Systems” - 2nd Edition, Tata McGraw-Hill

24ICxxxP					Embedded Systems Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To impart knowledge of embedded system development.
- To familiarize with Microcontroller Boards and IDEs for Embedded System Development.
- To interface peripherals to Embedded Systems.
- To build a small-scale Embedded System.

Laboratory Sessions would be based on following topics but not limited to:

1. Familiarization with IDE and trainer kits/boards.
2. Program for blinking LED pattern generation.
3. Program for interfacing multi-digit 7 segment display and implementing counter.
4. Program for interfacing toggle and push button switches, simple keypad, and matrix keypad.
5. Program for interfacing Buzzer, Relay, DC motor, Servo motor, Stepper motor.
6. Program for interfacing LCD and displaying text on it.
7. Program for interfacing various sensors and displaying quantity on LCD.
8. Program for interfacing speech and voice recognition modules and controlling peripherals.
9. Program for interfacing camera modules.
11. Program for interfacing RS 232 serial modules and file transfer using it.
12. Program for interfacing Ethernet module and transferring files using it.
13. Program for interfacing wireless modules: Zig bee, Bluetooth, GSM modem, GPS module, RFID etc.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Remember the basic components, and architecture of embedded systems.
CO2- Understand programs using assembly language and C programming.
CO3- Apply the concepts of interfacing for embedded systems.
CO4- Analyze different scenarios of embedded systems.
CO5- Evaluate the working of different embedded systems.
CO6- Create a small-scale embedded system for real world applications.

TEXT/REFERENCE BOOKS

1. Shibu K. V, Introduction to Embedded Systems, TMH.
2. Frank Vahid, Tony Givargis, Embedded system design: A unified Hardware/Software introduction, Wiley.
3. Rajkamal, Embedded System: Architecture, Programming and Design, TMH.
4. Wayne Wolf, Morgan, Computer as Components: Principles of Embedded Computing System Design, Kaufmann Publication.
5. Muhammad Ali Mazidi, 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson education India.
6. Muhammad Ali Mazidi, AVR Microcontroller and Embedded Systems: Using Assembly And C, Pearson education India.
7. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems: Using Assembly And C, Pearson education India.

24ICxxxT					Digital CMOS and VLSI Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the characteristics and concepts related to the design of digital CMOS VLSI circuits/gates.
- To explore various CMOS logic styles, and design CMOS VLSI circuits/gates at the transistor level and layout level.
- To analyze the performance/power of digital CMOS VLSI circuits/gates.

UNIT 1 INTRODUCTION TO DIGITAL CMOS VLSI	08
Trends in VLSI/Semiconductor industry, related to technology (Moore's) scaling; ITRS Roadmap; Overview of semiconductor devices inherent in the MOSFET: MOSFET I/V Characteristics, MOSFET C/V Characteristics, Second Order Effects. DC Transfer Characteristics: CMOS inverter DC Characteristics, Beta Ratio Effects, Noise Margins, Pass Transistor DC Characteristics	
UNIT 2: CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION	12
RC Delay Model, Linear Delay Model, Logical Effort, Parasitic Delay, Delay in a Logic Gate, Delay in Multistage Logic Networks. Timing analysis delay models **Power:** Sources of power, Dynamic Power, Static Power, Energy-Delay optimization, Low-power design techniques.	
UNIT 3: DESIGN OF DIGITAL CMOS VLSI STANDARD AND COMPOUND GATES	14
Combinational Design: Circuit Families: Pass-transistor tree-based logic gates (and similar other logic styles – CPL, transmission gates, DPL, etc); Pseudo-NMOS logic; CVLS logic; Dynamic logic (domino, NP domino, Zipper); Hybrid logic style and examples (Full-Adder, MUX, XOR), Pitfalls of various families, Stick diagram. Sequential Design: Sequencing Static Circuits, Max-Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew, Circuit Design of Latches and Flip-Flops	
UNIT 4: Datapath and array subsystem design	8
Carry ripple adder, carry look ahead adder, Manchester carry chain adder, carry skip adder, carry select adder, shifters, multipliers, SRAM, DRAM, and other memories.	

Total: 42 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the pros and cons, and the trends related to scaling of the CMOS VLSI technology.
CO2 - Understand the characteristics, sub-parts, and regions of operation of the MOSFET, and use their I-V equations.
CO3 – Design of the combinational and sequential circuits using digital CMOS VLSI standard gates and compound gates, at the transistor –level.
CO4 - Estimate the performance/power of digital CMOS VLSI standard and compound gates.
CO5 - Analyze and compare various digital CMOS logic styles and gates/circuits.
CO6 - Create layouts of digital CMOS VLSI standard gates and compound gates, based on Lambda rules.

TEXT/REFERENCE BOOKS

- Neil Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design: A circuits and systems perspective", 3rd Edition, Pearson.
- Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits", 3rd Edition, Tata McGraw Hill.
- Robert F. Pierret, "Semiconductor Device Fundamentals", 1st Edition, Pearson.Prentice Hall.

XXXX					Digital CMOS and VLSI Design Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To learn how to create layout designs for CMOS circuits. This involves understanding the physical aspects of CMOS, like transistor placement, routing, and metal layers.
- To Use CAD (Computer-Aided Design) tools to simulate and verify the functionality of CMOS designs.
- To Gain proficiency in designing digital integrated circuits using CMOS technology. This includes understanding the basics of CMOS design, such as logic gates, flip-flops, and other digital building blocks.

List of experiments:

1. To derive the CMOS INV gate noise margins using DC analysis.
2. To design layout of the CMOS INV and perform the RCX extraction and measure the delays.
3. To design layout of the CMOS NAND2 and perform the RCX extraction and measure the delays.
4. To design layout of the CMOS NOR2 and perform the RCX extraction and measure the delays.
5. To measure the dynamic and static power consumption of the CMOS NAND gate.
6. To understand the FO4 delay and measure the FO4 delay of the INV.
7. To apply the Logical effort technique to reduce the path delay.
8. To design layout of the Pass transistor AND2 and perform the RCX extraction and measure the delays.
9. To design layout of the DOMINO NAND2 and perform the RCX extraction and measure the delays.
10. To design layout of the Psuedo-NMOS NOR2 and perform the RCX extraction and measure the delays.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: Identify the pros and cons, and the trends related to VLSI Design.
CO2: Create layout designs for CMOS circuits and measure the performance metrics.
CO3: Understand the physical aspects of CMOS, including transistor placement, routing, and the use of metal layers.
CO4: Use CAD tools to simulate and verify the functionality of CMOS designs.
CO5: Perform static timing analysis to ensure that CMOS circuits meet their timing constraints.
CO6: Use techniques for minimizing power consumption in CMOS circuits. Understand the trade-offs between speed, power, and area.

TEXT/REFERENCE BOOKS

19. Neil Weste, David Harris, Ayan Banerjee, “CMOS VLSI design: A circuits and systems perspective”, 3rd Edition, Pearson.
20. Sung-Mo Kang, Yusuf Leblebici , “CMOS Digital Integrated Circuits”, 3rd Edition, Tata McGraw Hill.

Program Core Elective

5th Semester

<Course Code>					Optimization Methods and Algorithms					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To learn the fundamentals of optimization techniques.
2. To be able to understand, analyze, and solve constrained and unconstrained optimization problems.
3. To apply optimization techniques to solve diverse problems.

UNIT I: INTRODUCTION AND MATHEMATICAL PRELIMINARIES	**09 Hrs.**
Introduction to optimization and engineering optimization problems, Classification of optimization problems and algorithms, Simple application examples, Univariate and multi variate general (nonlinear) optimization problem formulations: Maxima and Minima. Mathematical Preliminaries: vectors, norm, inner product, matrices, eigen values and vectors, Definiteness, Multi-variate linear, affine and quadratic functions, Gradient vector and Hessian matrix, Matrix calculus, Convex/Concave set and functions.	
UNIT II: MULTIVARIATE OPTIMIZATION METHODS AND ALGORITHMS	**15 Hrs.**
Multi-variate non-linear optimization methods without constraints: Optimality conditions, Gradient based optimization algorithms: Newton's method, steepest descent, line search, conjugate gradient., Gradient free and approximation algorithms: Downhill Simplex, BFGS and Trust region algorithms., Equality constraints: Lagrange Multiplier method., Inequality constraints: KKT conditions, Convex optimization methods: Quadratic programming, Least square problem, Penalty function, Minimax optimization, Solution using KKT conditions, Newton's method, Barrier functions and interior point methods, Sequential quadratic programming, Separable programming.	
UNIT III: LINEAR AND INTEGER PROGRAMMING METHODS AND ALGORITHMS	**9 Hrs.**
Linear programming: Graphical method, Simplex algorithm, Duality and applications, Integer linear programming, Cutting plane and Branch and bound methods, Applications.	
UNIT IV: MODERN METHODS OF OPTIMIZATION – META-HEURISTIC TECHNIQUES	**9 Hrs.**
Introduction to nature inspired optimization, Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization, Applications, Introduction to multi-objective optimization.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Understand the need of optimization methods for engineering problems.
CO2	:	Describe unconstrained optimization and constrained optimization methods and algorithms.
CO3	:	Apply optimization techniques to solve linear and non-linear optimization problems.
CO4	:	Analyze and formulate different optimization problems.
CO5	:	Evaluate performance of various optimization techniques and algorithms.
CO6	:	Develop solution to various engineering problems with different level of constraints.

TEXT/REFERENCE BOOKS

5. Xin-She Yang, "Optimization Techniques and Applications with Examples", John Wiley & Sons Publication.
6. Xin-She Yang, "Engineering Optimization: An Introduction with Metaheuristic Applications", John Wiley & Sons Publication.
7. S.S. Rao, "Engineering Optimization: Theory and Practice", John Wiley & Sons Publication.
8. Kalyanmoy Deb, "Optimization For Engineering Design: Algorithms and Examples", Prentice Hall India Learning Private Limited, 2012.

24IC301T					Web Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn fundamentals of web development.
- To learn client side scripting with JavaScript.
- Demonstrate the use of ECMAScript to fulfil the essentials of front-end development.
- Implement UI-UX using React.js library and to create responsive web applications.

UNIT 1 Foundations of Web Development and Design	**7 Hrs.**
Introduction to WWW : Protocols and programs, secure connections, application and development tools, the web browser, What is server, choices, setting up UNIX and Linux web servers, Logging users, dynamic IP Web Design: Web site design principles, planning the site and navigation, Introduction to HTML : The development process, Html tags and simple HTML forms, web site structure Introduction to XHTML : XML, Move to XHTML, Meta tags, Character entities, frames and frame sets, inside browser	
UNIT 2: Styling and Interactivity with CSS and JavaScript	**6 Hrs.**
Style sheets : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, JavaScript : Client side scripting, What is JavaScript, How to develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition	
UNIT 3 : Modern JavaScript and ECMAScript	**7 Hrs.**
Modern JavaScript concepts, JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations DHTML : Combining HTML, CSS and JavaScript, events and buttons, controlling your browser, Introduction to ECMAScript 6 JavaScript Variables - var, let, const, JavaScript Objects, JavaScript Events, JavaScript Array Methods, JavaScript Regular Expressions DOM Manipulation JavaScript Best Practices	
UNIT 4 : Front-end Web Development with React.js	**8 Hrs.**
Introduction to Frontend web development, Single page web applications, Fundamentals of React.js, Components: Class Components and Functional Components, React Hooks - useEffect, useReducer, useContext, useCallback, fetching data with React Hooks, JSX, Props, Methods as props, State and setState, Destructuring props and state.	

Total: 280rs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Learn the Web Design Concepts including WWW, HTTP protocol and Browser.
CO2 – Understand the design and style concepts of webpages using HTML and CSS
CO3 – Implement JavaScript functionality to make interactive webpages
CO4 – Demonstrate the use of ECMAScript 6 to fulfil the essentials of front-end development.
CO5 – Implement UI-UX using React.js framework and Responsive web designing for Web Applications
CO6 – Build a complete web solution for a given problem statement

TEXT/REFERENCE BOOKS

1. Terry Felke-Morris, Web Development and Design Foundations with HTML5 - Pearson Education.
2. David Flanagan, JavaScript: The Definitive Guide– O'REILLY .
   David Griffiths and Dawn Griffiths, React Cookbook – O'REILLY

<Course Code>					Problem solving through Java					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the basic concepts and fundamentals of platform independent object-oriented language.
2. To demonstrate skills in writing programs using exception handling techniques and multithreading.
3. To understand streams and efficient user interface design techniques

UNIT I: CONCEPTS OF CLASSES AND OBJECTS	**12 Hrs.**
Introduction to java, java buzzword, data types, dynamic initialization, scope and life time, operators, control statements, arrays, type conversion and casting, finals & blank finals. Classes and Objects: Concepts, methods, constructors, usage of static, access control, this key word, garbage collection, overloading, parameter passing mechanisms, nested classes and inner classes. Basic concepts, access specifiers, usage of super key word, method overriding, final methods and classes, abstract classes, dynamic method dispatch, Object class	
UNIT II: INTERFACES	**10 Hrs.**
Differences between classes and interfaces, defining an interface, implementing interface, variables in interface and extending interfaces. Packages: Creating a Package, setting classpath, Access control protection, importing packages. Exception Handling: Concepts of Exception handling, types of exceptions, usage of try, catch, throw, throws and finally keywords, Built-in exceptions, creating own exception sub classes.	
UNIT III: STRINGS	**10 Hrs.**
Exploring the String class, String buffer class, Command-line arguments. Library: Date class, Wrapper classes Multithreading: Concepts of Multithreading, differences between process and thread, thread life cycle, Thread class, Runnable interface, creating multiple threads, Synchronization, thread priorities, inter thread communication, daemon threads, deadlocks.	
UNIT IV: APPLETS AND EVENT HANDLING	**10 Hrs.**
Concepts of Applets, life cycle of an applet, creating applets, passing parameters to applets, accessing remote applet, Color class and Graphics. Events, Event sources, Event classes, Event Listeners, Delegation event model, handling events.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Understand the use of abstract classes.
CO2	:	Understand the reusable programs using the concepts of inheritance, polymorphism, interfaces, and packages.
CO3	:	Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.
CO4	:	Utilize modern tools and collection framework to create java applications to solve real world problems.
CO5	:	Develop applets for web applications.
CO6	:	Design event driven GUI and web related applications which mimic the real word scenarios.

TEXT/REFERENCE BOOKS

1. Herbert Schildt, "**Java the Complete Reference 9th Edition**", McGraw Hill Education (India) Private Limited, New Delhi.
2. H.M. Dietel and P.J.Dietel, "**Java How to Program**", Sixth Edition, Pearson Education/PHI.
3. Y.DanielLiang "**Introduction to Java programming**", By, Pearson Publication

6th Semester

Course Code: XXXX					Machine Learning					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basics of Machine Learning
- Explain various Machine Learning Algorithms
- Analyze and design various architectures of Machine Learning algorithms.

UNIT 1 Fundamentals of Machine Learning	**9Hrs.**
Concept of data and their dimensions; Concept of feature and dimension of data; concept of Array, Matrix, and Tensor representation of data; concept of data preprocessing, data imbalance, Outliers, data sampling, feature engineering, Various dimensionality reduction techniques; correlation of features; concept of hypothesis and optimization; concept of classification and regression; Various evaluation Matrix: absolute error, Square error, Sum of square error, Mean Square error, log loss, accuracy, precision, recall, ROC, AUC, F1 score, confusion matrix; concept of Bias and variance .	
UNIT 2: Optimization methods	**7 Hrs.**
Concept of optimization; concept of convex optimization; local minima and maxima; Gradient Descent; concept of learning rate; Stochastic Gradient Descent (SGD); Mini-Batch Gradient Descent; concept of momentum; Adaptive Gradient Algorithm (AdaGrad); RMSProp; Adam Optimization;	
UNIT 3: Clustering, Classification, and regression algorithms	**8 Hrs.**
Partitioning Clustering; Density-Based Clustering; Distribution Model-Based Clustering; Hierarchical Clustering; Fuzzy Clustering; DBSCAN; K-Nearest Neighbors (KNN); Naive Bayes; Decision Tree; Random Forest; Support Vector Machine (SVM); Logistic Regression; XGBoost; Neural Network, Linear regression, Polynomial Regression; Stepwise Regression; Random Forest Regression; concept of boosting and bagging; Concept of overfitting, underfitting, Bias-Variance Tradeoff.	
UNIT 4: Various applications of Machine learning	**4 Hrs.**
Applications of ML in: Healthcare, Finance, Transportation, Manufacturing; energy and environment, Agriculture; Case study: Current Trends and Future of Machine Learning	

Total: 28Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Remember the concept of Machine learning.
CO2: Understand the basic algorithms.
CO3: Apply different algorithms to solve problems.
CO4: Analyze the advantages and disadvantages of various ML algorithms.
CO5: Evaluate the performance of ML algorithms.
CO6: Design an ML algorithm for a specific application.

TEXT/REFERENCE BOOKS

1. Introduction to Machine Learning with Python, Andreas C. MŸller, Shroff/O'Reilly publication.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron, O'Reilly publication.
3. Deep Learning textbook, Ian Goodfellow, http://www.deeplearningbook.org

24ICxxxT					Cloud Architecture and Services					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basics of Cloud Architecture
- Explain different types of business and deployment models in cloud.
- Analyze and design different architecture for cloud.

UNIT 1 Fundamentals of Cloud computing and its Architectures	**13Hrs.**
History of computing, Distributed computing, introduction to cloud, virtualization and abstraction, elasticity in cloud, concept of hypervisor, Advantages and limitations of virtual machines, containers, difference between VM and container, virtual networking, Service level agreement.	
UNIT 2: Various architectures of Cloud	**14Hrs.**
Introduction to business models and their architectures, SAAS, PAAS, IAAS, XAAS, Various cloud deployment models and their architectures, Public Cloud, Private cloud, Hybrid Cloud, community cloud, open-source platforms to develop cloud.	
UNIT 3: Data Processing in Cloud	**10 Hrs.**
Load balancing, dynamic and static load balancing, Distributed file system, HDFS, Apache Spark, writing and downloading files in cloud using DFS, data analytics in cloud.	
UNIT 4: Various applications of Cloud	**5 Hrs.**
Cloud based analytics, Cloud based smart applications, Cloud applications in Industry 4.0, Role of cloud in AI applications, Case Study: Design of personal cloud using open-source platforms.	

Total: 42Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Remember the architectures of cloud.
CO2: Understand the basic backbone of cloud.
CO3: Apply different concept of elasticity in cloud.
CO4: Analyze the advantage, disadvantages of various cloud architectures.
CO5: Evaluate the performance of various cloud infrastructures.
CO6: Design the architectures of cloud.

TEXT/REFERENCE BOOKS

1. Cloud Computing: Concepts, Technology & Architecture, by Thomas Erl, Ricardo Puttini, Zaigham Mahmood, PHI publication.
2. Architecting the Cloud: Design Decisions for Cloud Computing Service Models, Michael J. Kavis, Wiley publication.

24ICXXXT					Advanced Web Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn fundamentals of modern web development.
- To learn client side scripting with ECMAScript.
- Understand the use of MongoDB as an open-source NoSQL database to store and retrieve information.
- Create a Real-time responsive web application using MERN STACK technologies.

UNIT 1: Introduction to UI and UX in Web Development	**6 Hrs.**
Visual elements of User Interface Design, Ideation, Articulation and development in UX Design, Look and Feel/Visual Research, Developing and Refining UI, Sitemap, Wireframes and Prototypes, Fundamentals of HTML, CSS and JavaScript, Pseudo classes, Pseudo-elements, Transitions, Animations, Positioning, Box Model, Bootstrap 4, Material-UI, Basics of Responsive website using media queries, DOM Manipulation, Handling Events using JavaScript, Regular Expressions	
UNIT 2: Front-end Web Development with React.js	**7 Hrs.**
Fundamentals of React.js, Components: Class Components and Functional Components, Basics of Form Handling, Controlled Forms and form Validation, Uncontrolled Components and forms, The Model-View-Controller Framework, The Flux Architecture, Introduction to Redux, React Redux Forms, React Redux Form Validation, Client-Server communication, HTTP Get Request, HTTP Post Request, React Render: Rendering, useState, state immutability, parent and child components, State Management	
UNIT 3 : Server-side Development with Node.js, Express and MongoDB	**10 Hrs.**
Introduction to Server-side Development: Node, Node modules, Node HTTP server, Application Programming Interface, Express Framework and Rest API using Express, HTTPS and Secure Communication, Cross-Origin Resource Sharing, Basic Authentication, Session Based Authentication and Token Based Authentication, JSON Web Tokens, Passport module, OAuth and User Authentication, Backend as a Service, Integrating the React Client and Server, MongoDB and Mongoose	
UNIT 4 : Deployment of MERN Stack Web Applications	**5 Hrs.**
Fundamentals of Secure Deployment, Search Engine Optimization, DNS Record Management, Deploying MERN Stack Application on Web, Free Hosting Platforms, GitHub, Firebase, Heroku	

Total: 28Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand various technologies and trends impacting Single Page Web applications.
CO2 - Understand the use of MongoDB as an open-source NoSQL database to store and retrieve information.
CO3 - Apply a deep knowledge of MVC (Model View Controller) architecture, making the development process easier and faster using open-source technologies.
CO4 - Demonstrate the use of JavaScript to fulfil the essentials of front-end development to back-end development.
CO5 - Implement UI-UX using React.js framework and Responsive web designing for Web Applications.
CO6 - Create a Real-time responsive web application using MERN STACK technologies.

TEXT/REFERENCE BOOKS

1. O'Reilly, “Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node”, Media Publications
3. Chris Northwood, “The Full Stack Developer”, Apress Publications.
4. Greg Lim, “Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App”,
5. Shama Hoque, “Full-Stack React Projects”, Packt Publishing

24ICxxxT					Image Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To foster critical thinking skills by encouraging students to analyze and interpret the results of image processing and computer vision techniques in various applications.
- To demonstrate skills in problem-solving to identify, formulate, and solve image processing and computer vision problems using appropriate methodologies and tools.
- To encourage students to explore interdisciplinary connections by examining usage of image processing.

UNIT 1 Concepts of Digital image processing	**10 Hrs.**
Introduction to image basics, imaging systems, image representation, binary images, grayscale images, color images, multispectral and hyperspectral images, digital image file formats, introduction to image analysis tools, Human Visual Perception and Illusion, Image Fidelity	
UNIT 2 Digital Image Analysis	**10 Hrs.**
Overview of image analysis, preprocessing, region of interest, arithmetic and logic operations, thresholding, connectivity concept, basic object features, segmentation, edge, line detection, Image transforms, DFT, FFT, DCT, WHT, principle component, HAAR transform, filtering. Image enhancement, restoration, compression, registration,	
UNIT 3 : Feature extraction and Analysis	**12 Hrs.**
Feature Extraction, Shape Features, Histogram Features, Color Features, Spectral Features, Texture Features, Feature Analysis, Feature Vectors and Feature Spaces, Distance and Similarity Measures, Data Preprocessing, Pattern Classification algorithms and Methods, Neural networks for image analysis, deep learning,	
UNIT 4 : Applications of image processing	**10 Hrs.**
Medical image processing, Biometric recognition systems, Autonomous navigation, Image translation.	

Total:42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Recognize fundamental concepts in digital image processing
CO2: Comprehend the principles behind image analysis techniques
CO3: Apply various computer vision algorithms to solve real-world problems.
CO4: Evaluate the performance of different image processing algorithms in terms of accuracy, efficiency, and robustness
CO5: Design image processing systems for specific applications to achieve desired functionalities
CO6: Implement image processing algorithms in practical scenarios using functional software solutions.s

TEXT/REFERENCE BOOKS

1. Gonzalez, Rafael C. Digital image processing. Pearson education India.
2. Umbaugh, Scott E. Digital image processing and analysis: human and computer vision applications with CVIPtools. CRC press.
3. Sonka, Milan, Vaclav Hlavac, and Roger Boyle. Image processing, analysis and machine vision. Springer.
4. Dey, Sandipan. Python image processing cookbook, Packt Publishing Ltd.

<Course Code>					Statistical Signal Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Introduce mathematical ideas for analysis of random signals and statistical algorithms.
2. Show applicability of statistical analysis in wide range of engineering applications.
3. Explore tools for statistical signal analysis and characterization.

UNIT I: FUNDAMENTALS OF RANDOM SIGNAL PROCESSING	**11 Hrs.**
Review of Statistical Measures and Probability distribution functions, Continuous and Discrete time random processes, Stationarity, Ergodicity, Wide Sense stationarity, Covariance, Correlation and Power Spectral density, Filtering of random processes, Spectral factorization, Wold Decomposition.	
UNIT II: ESTIMATION THEORY	**12 Hrs.**
Maximum Likelihood, Fisher Information, Cramer Rao bound, MAP estimation, MMSE estimation, Non parametric spectral estimation, Periodogram, windowing, Parametric spectral estimation, AR and ARMA modelling, Yule Walker equations, Applications to signal modeling, design of digital communication receivers, channel estimation and forecasting systems.	
UNIT III: ADAPTIVE FILTERING	**12 Hrs.**
Wiener filter, LMS algorithm, recursive least squares, Kalman filters and its variants, Constant modulus algorithm, Adaptive beam forming and generalized side lobe canceller, Applications to noise cancellation, echo cancellation, channel equalization, system identification, linear prediction etc.	
UNIT IV: STATISTICAL SOURCE SEPARATION TECHNIQUES	**07 Hrs.**
The cock tail party problem, Independent component analysis, Blind Source Separation, Partial correlations and concentration matrix, Granger and other causality measures. Applications to speech enhancement, speaker separation etc.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Outline characteristics of random signals, statistical models and algorithms.
CO2	:	Understand classification of statistical signal processing algorithms to be applied in different situations.
CO3	:	Apply statistical signal processing algorithms to various applications like signal estimation and detection.
CO4	:	Analyze and compare performance of statistical signal processing algorithms.
CO5	:	Implement existing statistical signal processing algorithms using modern tools for various engineering applications.
CO6	:	Design a block diagram level simple statistical signal processing system

TEXT/REFERENCE BOOKS

1. Statistical Digital Signal Processing and Modelling, Monson H Hayes, Wiley India.
2. Fundamentals of Statistical Signal Processing: Estimation Theory: Vol. 1, Steven M Kay, Pearson Indian Edition.
3. Modern Spectral Estimation, Theory and Application, Steven Kay, Pearson Indian Edition.
4. Linear Estimation, Thomas Kailath, Pearson Education.
5. Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering, and Array Processing, Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, McGraw-Hill..

7th Semester

24ICxxxT					Cryptography and Network Security					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concept of security requirements, security attacks, and security policy.
- To understand the mathematical concepts for cryptographic algorithms.
- To be able to secure a message over insecure channel by various means.
- To understand the security analysis of cryptographic algorithms.
- To understand various protocols for network security to protect against the threats in the networks.

UNIT 1: INTRODUCTION AND BACKGROUND	**12 Hrs.**
Introduction to Cryptography, Security Threats, Vulnerability, Active and Passive attacks, Security services and mechanism, Conventional Encryption Model, CIA model, Classical Cryptographic Techniques, Introduction to Modular Arithmetic and Number Theory.	
UNIT 2: SYMMETRIC AND ASYMMETRIC KEY CRYPTOGRAPHY	**10 Hrs.**
Block Ciphers (DES, AES) : Feistal Cipher Structure, Simplifies DES, DES, Double and Triple DES, Block Cipher design Principles, AES, Modes of Operations, Public-Key Cryptography : Principles Of Public-Key Cryptography, RSA Algorithm, Diffie- Hellman Key Exchange.	
UNIT 3: HASH FUNCTION AND DIGITAL SIGNATURE	**10 Hrs.**
Authentication Requirement, Functions, Message Authentication Code, Hash Functions, Security Of Hash Functions And Macs, MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signatures, Key Management.	
UNIT 4: SECURITY IN NETWORKS	**10 Hrs.**
Threats in networks, Electronic mail Security, IP Security, Web security, System Security, Firewall.	

Total: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Define the importance of security policies, basic concepts of cryptography, and cryptanalysis
CO2: Apply appropriate encryption techniques to secure data in transit across data networks.
CO3: Analyze cryptography algorithms with the knowledge of security requirements and security attacks
CO4: Evaluate the authentication and hash algorithms as per security requirements.
CO5: To examine the issues and structure of Authentication Service and Electronic Mail Security
CO6: Discuss the security analysis of framework and policies applied in real life applications.

TEXT/REFERENCE BOOKS

21. William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson Education
22. Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw-Hill Education
23. William Stallings , “Network Security Essentials: Applications and Standards”, Prentice Hall
24. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education.

<******>					< Optical Communication >					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To introduce the students to various optical fiber modes, configurations, and various signal degradation factors associated with optical fiber
2. To understand various optical sources and optical detectors
3. To understand the optical communication system, optical amplifiers.
4. To study different fiber network elements and basic optical components.

UNIT I: OPTICAL FIBER BASICS	**11 Hrs.**
Introduction to Optical Fiber, Wave Propagation in Step-Index & Graded-Index Fiber, Modes & Rays. Basic Optical Communication System, Advantage and applications of Optical Communication System, Absorption, Scattering, Overall Fiber Dispersion-Single Mode Fibers, Multimode Fibers, Polarization.	
UNIT II: COMPONENTS OF OPTICAL FIBER COMMUNICATION SYSTEMS	**10 Hrs.**
Couplers, Isolators and Circulators, Multiplexers and Filters, Lasers, Light-Emitting Diodes, Photodetectors, Switches, Wavelength Converters.	
UNIT III: OPTICAL AMPLIFIERS	**9 Hrs.**
Stimulated Emission, Spontaneous Emission, Erbium-Doped Fiber Amplifiers, Raman, Semiconductor Optical Amplifiers, Crosstalk in SOAs, Crosstalk and Noise.	
UNIT IV: OPTICAL NETWORKS	**12 Hrs.**
SONET/SDH, Optical Transport Network, Optical Access Network, Ethernet, Network Topologies. Advanced Multiplexing Strategies- OFDM, SDM. Subcarrier Multiplexing, WDM Network Architectures, Few Advanced Topics: Flexible Optical Networks, Optical Neural Network, Cognitive Optical Network.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

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

CO1	:	Remember the basic concepts of optical fiber structure and optical communication systems.
CO2	:	Understand different design aspects of optical fiber including its advantages and limitations.
CO3	:	Apply optical fiber and optical communication concepts.
CO4	:	Analyze the system performance of optical transmitters, receivers, and optical amplifiers.
CO5	:	Evaluate the design of optical fiber communication systems.
CO6	:	Create optical communication applications in the recent technological trends.

TEXT/REFERENCE BOOKS

1. Gerd Keiser, "**Optical Fiber Communications**", 4th Edition McGraw Hill.
2. John M. Senior, "**Optical Fiber Communication**" PHI/Pearson.
3. G. P. Agrawal, "**Fiber optic Communication Systems**", John Wiley and sons.
4. John Gowar, "**Optical Communication Systems**" Pearson.

<Course Code>					Internet of Things					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

4. To impart knowledge about components of IoT, architecture, and platforms of IoT.
5. To apprise students with basic knowledge of IoT that paves a platform to understand physical, logical design, and business models.
6. To teach a student how to analyse requirements of various industrial systems for cost-effective design of IoT applications on different IoT platforms.
7. To explain the students how to design IoT applications in different domains and real time scenarios

UNIT 1 INTRODUCTION	**11 Hrs.**
Definition & Characteristics of IoT, Technology evolution, IoT Architectures, Physical and Logical Design of IoT, IoT Functional Blocks, IoT Communication Models- Publish-subscribe, Push-Pull, exclusive-pair models, Resource management, IoT Security, Current challenges and issues.	
UNIT 2 IoT DEVICES AND TECNOLOGIES	**12 Hrs.**
Introduction to various types of sensors, Working principles of sensors, Actuators, Control Units-Microcontrollers and Microprocessors, I/O interfaces, Communication Technologies for IoT, RFID, IoT Enabling Technologies – AI, Bigdata Analytics, Cloud Computing, and Embedded Systems.	
UNIT 3 INDUSTRIAL IoT	**9 Hrs.**
Introduction to Industrial IoT, Role of Industrial Internet of Things (IIoT), Difference between IoT and IIoT, Business Models, IoT-based real-time control systems and Human-Machine Interface, Supervisory Control & Data Acquisition (SCADA), Case studies on Smart Factories with IIoT.	
UNIT 4 IoT SYSTEMS AND APPLICATIONS	**10 Hrs.**
Applied Internet of Things, Smart Cities, Smart Agriculture, Intelligent Transportation Systems, IoT Applications for Smart Health Care, Home Automation, Environment Monitoring, and Surveillance, Case Studies Illustrating IoT Design.	

Max. 42 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1	:	Remember the Internet of Things and its technological aspects.
CO2	:	Comprehend advanced IoT devices and technologies for different IoT applications.
CO3	:	Apply the knowledge of control units and communication technologies in designing IoT systems.
CO4	:	Analyse the Industrial systems with IoT components.
CO5	:	Evaluate efficiency trade-offs among alternative models for an efficient IoT application design
CO6	:	Design different IoT systems for various real-life problems and application domains

TEXT/REFERENCE BOOKS

3. Pethuru Raj and Anupama C. Raman. The Internet of Things: Enabling Technologies, Platforms, and Use Cases. CRC Press.
4. Adrian McEwen. Designing the Internet of Things. Wiley publications.
5. Vijay Madisetti, Arshdeep Bahga. Ïnternet of Things: A Hands-on Approach. University Press.
6. Raj Kamal. Internet of Things: Architecture and Design. McGraw Hill

24ICxxxT					Modern Wireless Communications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand wireless communication evolution, cellular concepts, and system design.
- Analyze radio wave propagation and multipath fading in wireless systems.
- Evaluate performance of wireless communication systems in the presence of fading.
- Explore diversity, multiplexing, and access techniques for enhanced wireless communication.

UNIT 1: Introduction to Wireless Communications	**09 Hrs.**
Evaluation of Wireless Communications (2G to 5G); Cellular Concept: System Design Fundamentals, Frequency Reuse, Handoff, Cochannel Interference and System Capacity	
UNIT 2: Mobile Radio Propagation	**12 Hrs.**
Path Loss and Shadowing: Radio Wave Propagation, Transmit & Receive Signal Models, Free-Space Path Loss, Shadow Fading; Statistical Multipath Channel Models: Narrowband and Wideband Fading, Rayleigh and Rician Fading Distribution; Channel Equalizer; Performance Analysis over Fading Channel: Outage Probability, Average Probability of Error, Capacity	
UNIT 3: Space-Time Diversity and Multiplexing	**11 Hrs.**
SIMO, MISO and MIMO Models; Receiver Diversity: Selection Combining, Equal Gain Combining, Maximal-Ratio Combining, Transmit Diversity: Alamouti Space-Time Coding Scheme. Spatial Multiplexing.	
UNIT 4: Multiple Access Techniques	**10 Hrs.**
Spread Spectrum Communication: Spread Spectrum Principles, Direct Sequence Spread Spectrum, Frequency Hoping Spread Spectrum; Multicarrier Modulation Schemes: Orthogonal Frequency Division Multiplexing (OFDM), Cyclic Prefix, Case Study: The IEEE 802.11a Wireless LAN Standard; Introduction to Next Generation Wireless Communication Technologies.	

Total: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Comprehend wireless system evolution, cellular concepts, and design fundamentals.
CO2: Analyze radio wave propagation, path loss, fading models, and multipath effects.
CO3: Evaluate wireless communication system performance under fading conditions.
CO4: Apply diversity, multiplexing, and access techniques for enhanced communication.
CO5: Understand multiple antenna systems to improve communication performance.
CO6: Utilize various multiple access techniques in modern wireless communication systems.

TEXT/REFERENCE BOOKS

25. A. Goldsmith, “Wireless Communications,” Cambridge University Press, 2005.
26. D. Tse and P. Viswanath, “Fundamentals of Wireless Communications,” Cambridge University Press, 2005.
27. T. S. Rappaport, “Wireless Communications: Principles and Practice,” 2nd Ed., Prentice Hall, 2002.
28. Yifei Yuan, Zhifeng Yuan, “5G New Radio Non-Orthogonal Multiple Access”, CRC Press, 2023.

<Course Code>					BLOCKCHAIN TECHNOLOGY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the concepts of block chain technology
2. To understand the consensus and hyper ledger fabric in blockchain technology.
3. To develop blockchain based solutions and write smart contract.

UNIT I: BLOCKCHAIN INTRODUCTION	10 Hrs.
History of blockchain, Growth of blockchain technology, Types of blockchain, Digital Money to Distributed Ledgers, Smart contracts, Blockchain Architecture, Use cases, Blockchain vs shared Database, Introduction to cryptocurrencies, Applications.	
UNIT II: BITCOIN	**11 Hrs.**
Concept of Double Spending, Hashing, Proof of work. Introducing Bitcoin, Bitcoin digital keys and addresses, Transactions, Blockchain mining. Bitcoin Network and payments, Bitcoin network, Wallets, Bitcoin payments, Innovation in Bitcoin, Bitcoin Clients and APIs. Alternative Coins. Limitations of Bitcoin.	
UNIT III: BLOCKCHAIN PLATFORMS	**11 Hrs.**
Ethereum, Hyperledger, IOTA, EOS, Multichain, Bigchain, etc. Advantages and Disadvantages, Ethereumvs Bitcoin, Design a new blockchain, Potential for disruption, Design a distributed application, Blockchain applications.	
UNIT IV: PRIVACY, SECURITY ISSUES IN BLOCKCHAIN	**10 Hrs.**
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining and 51% attacks; Sharding based consensus algorithms. Case Studies of blockchain in Finance, Management and Government	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

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

CO1	:	Understand the types, benefits and limitation of blockchain.
CO2	:	Understand the concepts of Bitcoin and their usage.
CO3	:	Apply security features in blockchain technologies.
CO4	:	Analyze distributed computing and cryptography related to blockchain
CO5	:	Evaluate Use smart contract in real world applications.
CO6	:	Create the smart contracts and Blockchain features for outside of currencies.

TEXT/REFERENCE BOOKS

1. Narayanan, Bonneau, Felten, Miller and Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press.
2. Josh Thompson, ‘Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming’, Create Space Independent Publishing Platform, 2017.
3. Imran Bashir, “Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained”, Packt Publishing.
4. Merunas Grincalaitis, “Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols”, Packt Publishing.
5. Mastering Block chain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017
6. Mark Gates, “Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money”, Wise Fox Publishing and Mark Gates 2017.
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, “Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer”, 2018.
8. Bahga, Vijay Madisetti, “Block chain Applications: A Hands-On Approach”, Arshdeep Bahga, Vijay Madisetti publishers 2017.

24ICXXXT					Mobile Application Development					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn fundamentals of Mobile development.
- Understand various technologies and business trends impacting mobile applications.
- Apply a deep knowledge of mobile devices, features, architecture and android functionality.

UNIT 1 Overview of Android Development	**9 Hrs.**
Android OS architecture, Introducing development framework, Dalvik virtual machine – DVM, android virtual device and SDK manager, developing and executing the first android application, android activities- creating an activity, managing the lifecycle.	
UNIT 2: User Interface Design and Interaction in Android Development	**10 Hrs.**
Working with Views- Text, Edit Text, Button, Radio Button, Checkbox, Image Button, Toggle Button, Rating Bar, Working with View Groups- Linear Layout, Relative Layout, Constraint Layout, Scroll View, Table, Frame, Table with Action Bar, Binding Data with the Adapter View Class- List View, Spinner, Gallery View, Creating Menus & Dialogs	
UNIT 3 : Android Navigation and Fragment Management	**11 Hrs.**
Intent Objects, Intent Filters, Linking the Activities Using Intent, Obtaining Results from Intent, Passing Data Using an Intent Object, Fragments- Fragment Implementation, Finding Fragments, Adding, Removing, and Replacing Fragments	
UNIT 4 : Data Management and Connectivity in Android	**12 Hrs.**
Understanding SQLite Database and Data Types, Working with Cursors and Content Values in SQLite, Using SQLiteOpenHelper for Database Management, Adding, Updating, and Deleting Content in SQLite, Integrating XML & JSON Based Web Services, Introduction to Firebase for Android and Firebase Connectivity	

Total: 42Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand various technologies and business trends impacting mobile applications

CO2 – Apply a deep knowledge of mobile device, features, architecture and android functionality

CO3 – To explore and learn flutter to develop real time mobile applications

CO4 – Analyze and implement frameworks, database and design patterns in Mobile applications

CO5 – Learn to build features that have data persistence and data communications

CO6 – Create a mobile application using the Android programming language.

TEXT/REFERENCE BOOKS

1. Android Developer Tools Essentials by Mike Wolfson - O'Reilly Media Publications.
2. Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, Android Programming: The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 2nd edition.
3. Learn Java for Android Development, 2nd Edition - Jeff Friesen - Apress Publications