Sister Nivedita University

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School of Engineering
Department of Computer Science & Engineering

SYLLABUS
FOR
BACHELOR OF TECHNOLOGY (B. TECH) IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Regulations (R24) [NEP]

A Satyam Roychowdhury initiative

R24–25 Academic Session

Credit Definition

Type	Duration (in Hour)	Credit
Lecture (L)	1	1
Tutorial (T)	1	1
Practical (P)	2	1
Sessional (S)	2	1

Total Credit Distribution

Semester	Credits										Credits/Semester
	MC	ME	Project	NM	NV	MDC	AEC	SEC	VAC	INT	
1	11	0	0	4	2	0	2	0	2	0	21
2	16	0	0	1	4	2	0	0	2	0	25
3	16	4	0	0	2	2	0	0	2	0	26
4	18	0	0	1	0	2	0	0	3	0	24
5	10	4	0	4	1	3	0	0	3	0	25
6	5	8	0	4	0	0	0	4	0	0	25
7	0	0	4	4	0	0	0	0	0	4	12
8	0	0	8	0	0	0	0	0	0	0	8
Credits/Course	**76**	**16**	**12**	**20**	**12**	**9**	**8**	**9**	**6**	**4**	**172**

Category Definition

Definition of Category/Type	Abbreviation
Major Compulsory	**MC**
Major Elective	**ME**
Non-Major Specific Subject Course	**NM**
Non-major Vocational Education and Training	**NV**
Multidisciplinary Courses	**MDC**
Ability Enhancement Courses	**AEC**
Skill Enhancement Courses	**SEC**
Value Added Courses	**VAC**
Internship	**INT**

Program Outcomes (POs):

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyse engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural and engineering sciences.

PO3. Design/Development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety and the cultural societal and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO10. Communications: Communicate effectively with the engineering community and with the society at large. Be able to comprehend and write effective reports documentation. Make effective presentations and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

FIRST YEAR

SEMESTER-I

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Discrete Mathematics		MC	3	2	1	0
2	Fundamentals of Computer Science and Problem Solving		MC	3	2	1	0
3	Probability and Statistics		MC	4	3	1	0
4	NM Elective I: Digital Electronics		NM	3	2	1	0
5	Soft-Skill Development-I		NV	1	0	0	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-I		NV	1	3	1	0
7	Communicative English-I		AEC	2	2	0	0
8	Environmental Science-I		VAC	2	2	0	0
Practical							
9	Fundamentals of Computer Science and Problem Solving Lab		MC	1	0	0	2
10	Digital Electronics Lab		NM	1	0	0	2
				Total Credit=21			

SEMESTER-II

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Linear Algebra		MC	3	2	1	0
2	Functional Programming using C		MC	4	3	1	0
3	Computer Organization		MC	3	2	1	0
4	Signal and Systems		MC	3	2	1	0
5	Soft-Skill Development-II		NV	1	1	0	0
6	MDC1: Engineering Physics/ Electrical Engineering		MDC	4	3	1	0
7	Communicative English-II		AEC	2	2	0	0
8	Environmental Science-II		VAC	2	2	0	0
Practical							
9	Functional Programming using C Lab		MC	1	0	0	2
10	Computer Organization Lab		MC	1	0	0	2
11	Signals and Systems Lab		MC	1	0	0	2
				Total Credit=25			

SECOND YEAR

SEMESTER-III

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Data Structures		MC	4	3	1	0
2	Computer Architecture		MC	3	2	1	0
3	Formal Language and Automata Theory		MC	3	2	1	0
4	Object Oriented Programming with Java		MC	3	2	1	0
5	Numerical Methods and Programming/ Optimization Technique		ME	3	2	1	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-II		NV	1	0	0	2
7	Soft-Skill Development-III		NV	1	1	0	0
8	MDC II: Biology for Engineers		MDC	2	2	0	0
9	Foreign Language-I		AEC	2	2	0	0
Practical							
10	Data Structures Lab		MC	1	0	0	2
11	Computer Architecture Lab		MC	1	0	0	2
12	Object Oriented Programming with Java Lab		MC	1	0	0	2
13	Numerical Methods and Programming Lab/ Optimization Technique Lab		ME	1	0	0	2
				Total Credit=26			

SEMESTER-IV

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Operating Systems		MC	4	3	1	0
2	Database Management System		MC	4	3	1	0
3	Artificial Intelligence		MC	3	2	1	0
4	Design and Analysis of Algorithms		MC	4	3	1	0
5	Soft-Skill Development-IV		NV	1	1	0	0
6	SEC1: Advanced Programming Techniques with R and Python		SEC	3	1	0	4
7	Foreign Language-II		AEC	2	2	0	0
Practical							
8	Operating Systems Lab		MC	1	0	0	2
9	Database Management System Lab		MC	1	0	0	2
10	Artificial Intelligence Lab		MC	1	0	0	2
				Total Credit=24			

THIRD YEAR

SEMESTER-V

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Computer Networks		MC	4	3	1	0	0
2	Software Engineering and Agile Methodology		MC	4	3	1	0	0
3	Machine Learning/ Advanced Algorithms		ME	3	2	1	0	0
4	NM Elective-II: Digital Signal Processing/ VLSI Design		NM	4	3	1	0	0
5	Soft-Skill Development-V		NV	1	1	0	0	0
6	SEC2: Programming with Advanced Java		SEC	3	1	0	4	0
7	MDC III: Design Thinking/ Industrial Psychology		MDC	3	2	1	0	0
Practical								
8	Computer Networks Lab		MC	1	0	0	2	0
9	Software Engineering and Agile Methodology Lab		MC	1	0	0	2	0
10	Machine Learning Lab/ Advanced Algorithms Lab		ME	1	0	0	2	0
Total Credit=25								

SEMESTER-VI

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Machine Learning Operations		MC	4	3	1	0	0
2	Deep Learning and Applications/ Data Analytics and Visualization		ME	4	3	1	0	0
3	Natural Language Processing/ Cognitive Science/ Human Computer Interface		ME	4	3	1	0	0
4	NM Elective-III: Microprocessor and Microcontroller/ Information Theory and Coding		NM	4	3	1	0	0
5	Soft-Skill Development-VI		NV	1	1	0	0	0
6	Scientific and Technical Writing		NV	2	0	0	0	2
7	SEC3: Entrepreneurship Skill Development		SEC	3	2	1	0	0
8	VAC: Human Values and Ethics		VAC	2	2	0	0	0
Practical								
9	Machine Learning Operations Lab		MC	1	0	0	2	0
10	Deep Learning and Applications Lab/ Data Analytics and Visualization Lab		ME	1	0	0	2	0
Total Credit=25								

FOURTH YEAR

SEMESTER-VII

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Digital Transformation for Sustainable Society		NV	2	2	0	0	0
2	Project-I / Image Processing and Pattern Recognition		Project	4	0	0	0	8
3	Summer Internship		INT	4	0	0	0	8
4	NM Elective-IV: Wireless and Mobile Communication / Satellite Communication		NM	4	3	1	0	0
				Total Credit=14				

SEMESTER-VIII

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Project-II / Conversational Systems		Project	4	0	0	0	8
2	Project-II / Social Media Analytics		Project	4	0	0	0	8
3	NM Elective-V: Fiber Optic Communication / Sensors and Actuators		NM	4	3	1	0	0
				Total Credit=12				

FIRST YEAR

SEMESTER-I

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Discrete Mathematics		MC	3	2	1	0
2	Fundamentals of Computer Science and Problem Solving		MC	3	2	1	0
3	Probability and Statistics		MC	4	3	1	0
4	NM Elective I: Digital Electronics		NM	3	2	1	0
5	Soft-Skill Development-I		NV	1	0	0	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-I		NV	1	3	1	0
7	Communicative English-I		AEC	2	2	0	0
8	Environmental Science-I		VAC	2	2	0	0
Practical							
9	Fundamentals of Computer Science and Problem Solving Lab		MC	1	0	0	2
10	Digital Electronics Lab		NM	1	0	0	2
				Total Credit=21			

DISCRETE MATHEMATICS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Discrete Mathematics	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 1^{st}

THEORY

Learning objectives: On completion of the course, student will be able to: apply the knowledge of graph theory to solve complex engineering problem.

Prerequisite: Before learning the concepts of Discrete Mathematics, you should have a basic knowledge of set, relation, mapping, matrix etc.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Abstract Structure	10	21%
Module-II: Propositional Calculus	6	13%
Module-III: Counting Techniques	6	13%
Module-IV: Boolean Algebra and Combinatorial Circuits	6	13%
Module-V: Basics of Graph Theory	12	25%
Module-VI: Tree	8	17%

SYLLABUS OUTLINE:

Module I: Algebraic Structures: [10L]

Sets, algebra of sets and their applications, Relations, Mapping, Groups, Abelian groups, Subgroups, Cyclic groups, Permutation group, Definition of Ring, Field and simple related problems.

Module II: Propositional Calculus: [6L]

Proposition, propositional variables, combination of propositions ,Conjunction, Disjunction, Negation and their truth table, derived connectors. Conditional Connectives, Implication, Converse, Contrapositive, Inverse, Bi conditional statement swith truth table, Logical Equivalence, Tautology, Normal forms-CNF, DNF;Predicates and Logical Quantifications of propositions and related examples.

Module III: Counting Techniques: [6L]

Permutations, Combinations, Binomial coefficients, Pigeon-hole Principle, Principles of inclusion and exclusions; Generating functions, Recurrence Relations and their solutions using generating function,Recurrence relation of Fibonacci numbers and it's solution, Divide-and-Conquer algorithm and its recurrence relation and its simple application in computer.

Module IV: Boolean Algebra and Combinatorial Circuits: [6L]

Definition, Sub-Algebra, Isomorphic Boolean Algebra, Boolean functions and expressions, DNF and CNF, principle of duality, design of digital circuits, Applications of Boolean algebra in switching theory, series and parallel connections, Karnaugh Maps, minimization of Boolean expression using k-map.

Module V: Basics of Graph Theory: [12L]

Graphs, Simple and Multi graph,Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Sub graph, Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph.Eulerian Circuits, Hamiltonian paths, Vertex Degrees and Counting, Degree-sum formula, Havel-Kakimi Algorithm.

Module VI: Tree: [8L]

Definition and properties, Binary tree, Spanning tree of a graph, Minimum spanning tree, properties of trees, Graph Traversal algorithms: Depth First Search, Breath First Search, Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using Kruskal's and Prim's algorithms.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Topics in Algebra, I. N. Herstein, John Wiley and Sons.
2) Digital Logic & Computer Design, M. Morris Mano, Pearson.
3) Elements of Discrete Mathematics, (Second Edition) C. L. LiuMcGraw Hill, New Delhi.
4) Graph Theory with Applications, J. A. Bondy and U. S. R. Murty, Macmillan Press, London.
5) Mathematical Logic for Computer Science, L. Zhongwan, World Scientific, Singapore.

Reference Books:

1) Introduction to linear algebra. Gilbert Strang.
2) Introductory Combinatorics, R. A. Brualdi, North-Holland, New York.
3) Graph Theory with Applications to Engineering and Computer Science, N. Deo, Prentice Hall, Englewood Cliffs.
4) Introduction to Mathematical Logic, (Second Edition), E. Mendelsohn, Van-Nostrand, London.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	-	-	-	1
CO2	3	2	-	1	1	2	1	-	-	-	-	-
CO3	2	1	-	-	-	1	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	2	1	1	-	1	-	-	-	-	-
CO6	3	2	2	1	1	-	1	-	-	-	-	1
Avg.	2.5	1.5	0.67	0.67	0.5	0.5	0.5	-	-	-	-	0.5

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand fundamental algebraic structures

CO2: To be able to analyze logical propositions and truth tables

CO3: To be able to apply counting techniques to solve complex problems

CO4: To be able to design and simplify digital circuits using boolean algebra.

CO5: To be able to analyze and represent graphs in various mathematical forms.

CO6: To be able to apply tree and graph traversal algorithms to practical problems.

FUNDAMENTALS OF COMPUTER SCIENCE AND PROBLEM SOLVING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Fundamentals of Computer Science and Problem Solving	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 1^{st}

THEORY

Learning objectives:

1) To introduce students to a powerful programming language
2) To understand the basic structure of a program
3) To gain knowledge of various programming errors

Prerequisite: Basic Mathematics and analytics

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Fundamentals of Number System	4	10%
Module-II: General Problem-Solving concepts	6	17%
Module-III: Operators & Expressions	6	17%
Module-IV: Control and Iterative Flow	6	17%
Module-V: Functions and Program Structure with discussion on standard library	6	17%
Module-VI: Arrays and Storage Class	8	22%

SYLLABUS OUTLINE:

Module I: Fundamentals of Number System: [4L]

Generation of computer system, type of computer lanaguages, compiler vs. interpreter. Decimal Number, Binary Number, Octal Number, Hexadecimal Number, Conversion of number systems, r and $(r-1)$ Complement.

Module II: General Problem-Solving concepts: [6L]

Problem analysis, Flowchart, algorithms, Pseudo codes, structured programming, Example of Flowchart and Algorithm representation, Brief History of Development of C language, Features of C language, Process of compiling and running a C program

Module III: Operators & Expressions: [6L]

Keywords, token, identifier, and Constant, Classification of constants, data types (Primary data types, User defined data types, Derived data types), Different types of Operators (Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise, Special), expressions, type conversion, Operator precedence, associatively rules on operators, scanf() Format code, printf() Format code, reading and writing character variable, character testing functions (isdigit(), islower(), isupper(), tolower(), toupper()).

Module IV: Control and Iterative Flow: [6L]

If statement, Nested if, if else if ladder, switch case, ternary operator, goto statement (forward and backward jump), Different types of loop (while, for, do), entry control loop , exit control loop, Applying break and continue within loop

Module V: Functions and Program Structure: [6L]

Programming structure, Standard library functions, user-defined functions, Different types of function, recursion with example.

Module VI: Arrays and Storage Class: [8L]

One dimensional array, two dimensional array, Example using integer and floating array, scope of variables in function (auto, extern, static, register)

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Programming in ANSI C by E. Balaguruswamy, Tata McGraw-Hill Publications.
2) Let Us C, Yashavant Kanetkar, BPB Publications, 17th ed, 2020.

Reference Books:

1) Brian W. Kernighan and Dennis M. Ritchie The C Programming Language.
2) Jeri R Hanly Elliot B Koffman Problem solving and program design in C Person Addison Wesley 2006

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									1
CO2	3	3	3									1
CO3	3	3	3									1
CO4	3	3	3									1
CO5	3	3	3									1
CO6	3	3	3									1
Avg.	3	3	3									1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to develop an algorithm for solving a problem.

CO2: To be able to explain the utility of operators in C

CO3: To be able to make use of control statements for solving the related problems.

CO4: To be able to utilize the concept of user defined functions for breaking a problem into sub problems

CO5: To be able to solve different problems using pointers and arrays.

CO6: To be able to make use of structures for constructing a complex data type which is more meaningful and relevant?

PROBABILITY AND STATISTICS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Probability and Statistics	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 1^{st}

THEORY

Learning objectives: Learning basic statistical tools, types of qualitative and quantitative data, diagrammatic and graphical representation and organize, manage and present data. Acquire the knowledge about different measures of central tendency, dispersion, moments, skewness and kurtosis, bivariate data.

Prerequisite: Before learning the concepts of Probability for Computer Science, you should have a basic knowledge of basic mathematics.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Statistical Methods	6	15%
Module-II: Univariate Data Analysis	10	20%
Module-III: Bivariate Data Analysis	6	15%
Module-IV: Introductory Probability	10	15%
Module-V: Conditional Probability	8	15%
Module-VI: Random Variables and Generating Functions	8	20%

SYLLABUS OUTLINE:

Module I: Introduction to Statistical Methods: [6L]

Definition and scope of Statistics, concepts of statistical Population and Sample. Data: Quantitative and Qualitative, Discrete and Continuous, Cross-sectional and Time-series, Primary and Secondary. Scales of measurement: Nominal, Ordinal, Interval and Ratio. Presentation of data: textual, tabular and graphical. Frequency distributions, cumulative frequency distributions and their graphical representations

Module II: Univariate Data Analysis: [10L]

Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: Range, Mean deviation, Standard deviation, Quartile deviation, Coefficient of variation. Moments, Skewness and Kurtosis. Shep-

pard's corrections for Moments. Box Plot and Outliers detection.

Module III: Bivariate Data Analysis: [6L]
Definition, Scatter diagram, simple Correlation, simple linear Regression, principle of least squares, fitting of Polynomial and Exponential curves, Rank correlation: Spearman's (untied and tied cases).

Module IV: Introductory Probability: : [10L]
Introduction, Random Experiments, Sample Space, concept of three types of Sample Spaces – finite, countably infinite and uncountably infinite, Events and Algebra of Events, Definitions of Probability – Classical, Statistical and Axiomatic, applications.

Module V: Conditional Probability: [8L]
Conditional Probability, laws of Addition and Multiplication, theorem of Total Probability, Bayes' theorem and its applications, independent events.

Module VI: Random Variables and Generating Functions: [8L]
Definition, probability distribution of Random Variables, Cumulative Distribution Function (C.D.F.) and its properties (with proof), Discrete and Continuous Random Variables, Probability Mass Function (P.M.F.) and Probability Density Function (P.D.F.), Expectation and Moments, Dispersion, Skewness, Kurtosis, Quantiles.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Gun A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I, 8th Edition. World Press, Kolkata.
2) Gun A.M., Gupta M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory, Vol. I, World Press.
3) Gun A.M. and Roy D. (2006): Problems In Probability Theory, 2nd Edition, World Press.

Reference Books:

1) Ross S. (2002): A First Course in Probability, Prentice Hall.
2) Feller W. (1968): An Introduction to Probability Theory & its Applications, John Wiley
3) Uspensky J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1								1
CO2	3	3	2	2								1
CO3	3	3	2	1								1
CO4	3	3	2									1
CO5	3	3	2	2								1
CO6	3	3	2	2								1
Avg.	3	3	2	1.3								1.2

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Build knowledge about basic statistical methods and representations of data

CO2: Explain the concept of frequency distributions and their graphical presentations.

CO3: Make use of the knowledge about the measures of central tendency, measures of absolute and relative dispersion, moments, measures of skewness and kurtosis, measures of moments.

CO4: Apply the concepts of scatter diagram, simple correlation, rank correlation, simple linear regression and curve fitting

CO5: Apply the concepts of basic probability, concepts of conditional probability, Bayes' theorem and independent events, the fundamental knowledge of one dimensional discrete random variable and their related properties.

CO6: Build the fundamental knowledge of one dimensional continuous random variable and their related properties.

DIGITAL ELECTRONICS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Digital Electronics	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 1^{st}

THEORY

Learning objectives: To develop the concept and understanding of various number systems, realization of boolean algebra using logic gates, solve different types of combinational and sequential circuits, knowledge of ADC DAC and logic families

Prerequisite: High school Mathematics and knowledge of basic electrical elements

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Number Systems and Codes	6	16.66%
Module-II: Boolean Algebra	6	16.66%
Module-III: Logic Families	4	11.11%
Module-IV: Combinational Logic	6	16.66%
Module-V: Flip Flop	6	16.66%
Module-VI: Registers & Counters	8	22.22%

SYLLABUS OUTLINE:

Module I: Number Systems and Codes: [6L]

Binary, octal, hexadecimal and decimal Number systems and their inter conversion, BCD numbers (8421-2421), gray code, excess–3 code, code conversion, ASCII, EBCDIC codes. Binary addition and subtraction, signed and unsigned binary numbers, 1's and 2's complement representation

Module II: Boolean Algebra: [6L]

Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR and their truth tables, Universal Gates, Laws of Boolean algebra, De-Morgan's theorem, Min term, Max term, POS, SOP, K-Map, Simplification by Boolean theorems, don't care condition, Q-M method of function realization.

Module III: Logic Families: [4L]

Introduction to digital logic family such as RTL, DTL, TTL, ECL, CMOS, IIR, HTL etc., their comparative study, Basic circuit, performance characteristics, Wired logic, open collector output etc.

Module IV: : Combinational Logic: [6L]

The Half adder, the full adder, subtractor circuit, comparator, Multiplxer de-multiplexer, decoder, BCD to seven segment decoder, Encoders.

Module V: Flip Flop: [6L]

Set-reset laches, D-flipflop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T flip-flop.

Module VI: Registers & Counters: [8L]

Synchronous/Asynchronous counter operation, Up/down synchronous counter, application of counter, Serial in/Serial out shift register, Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Digital Fundamentals by Morris and Mano, PHI Publication
2) Fundamental of digital circuits by A. ANANDKUMAR, PHI Publication.

Reference Books:

1) Digital Fundamentals by FLOYD & JAIN, Pearsons Pub
2) Fundamentals of Logic Design by Charles H. Roth Thomson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	1
CO4	2	2	1	-	-	-	-	-	-	-	-	2
CO5	2	1	1	-	-	-	-	-	-	-	-	1
CO6	1	-	-	2	-	-	-	-	-	-	-	1
Avg.	2.16	1.67	1.33	0.5								1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the digital logic and grasping fundamentals of digital design.

CO2: Design the combinational logic circuits using Boolean expressions and logic gates to perform specific functions.

CO3: Analyze and learn the design of sequential logic circuits including flip-flops, registers, counters and understanding their behavior and use.

CO4: Identify and understand the concept of state transitions and developing a deep understanding of sequential logic, modeling complex systems and analyzing system behavior using finite state machines.

CO5: Explain how digital systems operate and achieve optimized system performance by choice of appropriate logic family and memory units such that the circuits meet performance, power and cost requirements.

CO6: Learning skills in simulating digital designs to verify functionality and timing, and also understanding the importance of verification methodologies.

SOFT-SKILL DEVELOPMENT-I

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Soft-Skill Development-I	**COURSE CREDIT:** 01[1-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: MVSSU122T01	**SEMESTER:** 1^{st}

THEORY

Learning objectives: The course is intended to familiarize students with the basics of English language and help them to learn to identify language structures for correct English usage. The course would enhance student's vocabulary, language and fluency.

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Essentials of English Grammar		30%
Module-II: Spoken English Communication		30%
Module-III: Vocabulary		20%
Module-IV: Introduction to Written English		10%
Module-V: Prose		10%

SYLLABUS OUTLINE:

Module I: Essentials of English Grammar: [L]

- Tenses
- Article
- Parts of Speech
- Sentence Structure
- Subject Verb Agreement
- Punctuations

Activities: Grammar worksheets, Bingo, Grammar puzzles, Quizzes, Conversations, Role Play

Module II: Spoken English Communication: [L]

- Introduction to phonetics
- Syllable, Consonant and vowel sounds
- Stress & Intonation
- Pronunciation & accent

Activities: Role Play, Picture description, Story Telling, Information Gap Activities, Audio & Video recordings

Module III: Vocabulary: [L]

- Use of dictionary
- Diminutives, Homonyms & Homophones
- Synonyms & Antonyms
- Idioms & Phases
- Vocabulary Drills

Activities: Word Association, Vocabulary Cards, Contextual word usage, quizzes

Module IV: Introduction to Written English: [L]

- Progression of Thought/ideas
- Paragraph Writing
- Essay Writing

Activities: Peer editing, writing prompts, sentence expansion

Module V: Prose: [L]

- "The Night Train at Deoli" by Ruskin Bond
- "The Postmaster" by Rabindranath Tagore
- "The Prospect of Flowers" by R.K. Narayan
- "The Woman on Platform No. 8" by Ruskin Bond
- "The Dog of Tithwal" by Saadat Hasan Manto

Comprehension Questions will be set in the End-Semester Exam

- ***Pedagogy for Course Delivery:*** Workshop, Group, Discussions, Presentations, Extempore.
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	2	3
CO2	-	-	-	-	-	-	-	-	1	3	2	3
CO3	-	-	-	-	-	-	-	-	1	3	1	3
CO4	-	-	-	-	-	-	-	-	1	3	2	3
CO5	-	-	-	-	-	-	-	-	2	3	2	3
CO6	-	-	-	-	-	-	-	-	1	3	2	3
Avg.	-	-	-	-	-	-	-	-	1.33	3	1.83	3

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To build a strong foundation in essential English language skills, fostering effective communication in diverse situations

CO2: To be learn to apply English language skills in real-world scenarios, improving their proficiency in both academic and professional settings.

CO3: To be able to acquire comprehensive knowledge of grammar, mastering the rules and structures necessary for accurate and effective communication.

CO4: To be able to enhance their listening skills, enabling them to comprehend spoken English in various contexts.

CO5: To expand vocabulary, learning new words and phrases to express more precisely and eloquently

CO6: To be able to write clearly and persuasively, as well as to read and analyse texts critically.

COMMUNICATIVE ENGLISH-I

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Communicative English-I	**COURSE CREDIT:** 02[2-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** AEC
CODE: AECEU041T01	**SEMESTER:** 1^{st}

THEORY

Learning objectives:

1) To know about Fundamentals of Communicative English and Communication Skills in general. To train to identify the nuances intonation and enhance pronunciation skills for better communication skills.
2) To impart basic English grammar and essentials of important language skills.
3) To enhance English vocabulary and language proficiency for better communication skills. To learn about Techniques of Information Transfer through presentation.

Prerequisite: Nil

Teaching-Learning Process (General Instructions):

These are sample strategies that teachers can use to accelerate the attainment of the various course outcomes.

1) Teachers shall adopt suitable pedagogy for an effective teaching-learning process. The pedagogy shall involve a combination of different methodologies that suit modern technological tools and software to meet the present requirements of the global employment market.

i) Direct instructional method (Low/Old Technology)
ii) Flipped classrooms (High/Advanced Technological Tools)
iii) Blended learning (Combination of both)
iv) Enquiry and evaluation-based learning
v) Personalized learning
vi) Problem-based learning through discussion
vii) Following the method of expeditionary learning tools and techniques
viii) Use of audio-visual methods through language labs in teaching of LSRW skills (Listening, Speaking, Reading, Writing)

2) Apart from conventional lecture methods, various types of innovative teaching techniques through videos and animation films may be adapted so that the delivered lessons can progress the students' theoretical, applied, and practical skills in teaching communicative skills in general.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Basics of the Theory of Communication	6	25%
Module-II: Development of Listening and Speaking Skills	6	25%
Module-III: Basic Writing Skills	6	25%
Module-IV: Reading and Comprehension	6	25%

SYLLABUS OUTLINE:

Module I: Basics of the Theory of Communication: [6L]

Fundamentals of Communicative English, process of communication, barriers to effective communicative English, different styles and levels in communicative English (communication channels). Interpersonal and intrapersonal communication skills, how to improve and develop interpersonal and intrapersonal communication skills.

Module II: Development of Listening and Speaking Skills: [6L]

Development of listening and speaking skills, appreciating effective communication/miscommunication, usage of dialogue.

Module III: Basic Writing Skills: [6L]

Email writing, letter writing.

Module IV: Reading and Comprehension: [6L]

How to summarize a text, effective paraphrasing, précis writing.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Communication Skills by Sanjay Kumar and Pushp Lata, Oxford University Press, 2019.

2) English for Engineers by N.P. Sudharshana and C. Savitha, Cambridge University Press, 2018.
3) A Textbook of English Language Communication Skills, Infinite Learning Solutions (Revised Edition), 2021.

Reference Books:

1) A Course in Technical English by D. Praveen Sam and K.N. Shoba, Cambridge University Press, 2020.
2) Technical Communication by Gajendra Singh Chauhan et al., Cengage Learning India Pvt. Limited (Latest Revised Edition), 2019.
3) English Language Communication Skills – Lab Manual cum Workbook, Cengage Learning India Pvt. Limited (Latest Revised Edition), 2019.
4) Practical English Usage by Michael Swan, Oxford University Press, 2016.
5) Technical Communication – Principles and Practice, Third Edition by Meenakshi Raman and Sangeetha Sharma, Oxford University Press, 2017.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	2	3
CO2	-	-	-	-	-	-	-	-	1	3	1	3
CO3	-	-	-	-	-	-	-	-	2	3	2	3
CO4	-	-	-	-	-	-	-	-	1	3	2	2
CO5	-	-	-	-	-	-	-	-	2	3	2	3
CO6	-	-	-	-	-	-	-	-	1	3	2	3
Avg.	-	-	-	-	-	-	-	-	1.33	3	1.83	2.83

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To understand the basics of communicative English and general communication skills.
CO2: To train to identify nuances in intonation and enhance pronunciation for improved communication.
CO3: To learn essential English grammar and foundational language skills.
CO4: To enhance English vocabulary for better language proficiency and effective communication.
CO5: To develop overall language proficiency to communicate confidently in various contexts.
CO6: To cultivate effective communication skills through comprehensive training in grammar, pronunciation, and vocabulary.

ENVIRONMENTAL SCIENCE-I

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Environmental Science-I	**COURSE CREDIT:** 02[2-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** VAC
CODE: XXXXXX	**SEMESTER:** 1^{st}

THEORY

Learning objectives:

1) To understand the basic concepts of components of atmosphere
2) To understand the classification of resources (perpetual, renewable, non-renewable)
3) To learn about the components of environment and individual resources
4) To learn about origin and importance of air, water, forest, food, land, mineral and energy resources
5) To become aware of the degradation of all above resources.

Prerequisite: Passed 10+2 in any discipline

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Components of Environment and Atmosphere	4	16.67%
Module-II: Water resource	4	16.67%
Module-III: Forest resource and Food resource	4	16.67%
Module-IV: Land resource	4	16.67%
Module-V: Mineral resource	4	16.67%
Module-VI: Energy resource	4	16.67%

SYLLABUS OUTLINE:

Module I: Components of Environment and Atmosphere: [4L]

Classification of natural resources (four atmospheric spheres); Perpetual, renewable and non-renewable resources.Names and compositions of different layers of atmosphere; introduction of pollutant and contaminant.

Module II: Water resource: [4L]

Classification and quantization of water resource; Sweet and saline water; Fresh water resource : surface water, water table and aquifer; use and over use of water; causes of flood and draught; conflict over water; benefit and harms of dams; water harvesting and our responsibilities.

Module III: Forest resource and Food resource: [4L]

Classification and importance of forest; use and over exploitation of forests; deforestation : cause (timber extraction, mining and dam construction)and effect (global warming, erosion, lower rain fall); afforestation : forest growth, preservation and laws, tribal people and forest.

Different types of foods their origin and their importance; global food problems; food production and food loss; modern agriculture, GM food.

Module IV: Land resource: [4L]

Importance of land as a resource and its classification; land fertility and degradation; over grazing and over cultivation; effect of pesticide and fertilizer, land erosion, landslide, desertification (by human activity).

Module V: Mineral resource: [4L]

Introduction of minerals and their classification; use and importance; effect of extracting mineral (mining) on environment.

Module VI: Energy resource: [4L]

Introduction and origin; Perpetual, renewable and non-renewable energy resources;growing energy needs; energy harvesting, green energy, alternative energy resources.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Environmental Science : Fundamentals, Ethics & Laws, Asish Shukla, Renu Singh, Anil Kumar, Wiley (2019)

Reference Books:

1) Environmental Science, Dr Biplab Kumar Das, Dr Mofidul Islam, Mahaveer Publications (2023)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	3	3					
CO2	3	2	1	1	2	3	3					
CO3	3	2	2	1	3	3	3					
CO4	3	2	2	1	3	3	3					
CO5	3	2	1	1	2	3	3					
CO6	3	2	1	1	2	3	3					
Avg.	3	2	1.33	1	2.33	3	3					

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: This part of Environmental science course include detailed description of different natural resources. Students will learn about origin, classification and importance of different resources as well as their and impact on human life.

CO2: This course deals with preservation of natural resources and not with pollution of them.

CO3: Classification of perpetual, renewable and non-renewable resources and the principles behind their preservation is included in the outcome of this course.

CO4: Classification of atmospheric layers as per their distance from earth surface and composition of different layers.

CO5: Students will learn about introduction, classification, importance,degradation and preservation of water, food, land and forest resources.

CO6: Students will learn about introduction, classification and importance of mineral and energy resources. Importance of energy harvesting and alternative energy resource will also be learned as an integral part of this course.

FUNDAMENTALS OF COMPUTER SCIENCE AND PROBLEM SOLVING LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Fundamentals of Computer Science and Problem Solving Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 1^{st}

List of Practical:

1) Write a c program to display the word “welcome”.
2) Write a c program to take a variable int and input the value from the user and display it.
3) Write a c program to add 2 numbers entered by the user and display the result.
4) Write a c program to calculate the area and perimeter of a circle.
5) Write a C program to find maximum between two numbers.
6) Write a C program to check whether a number is divisible by 5 and 11 or not.
7) Write a C program to input angles of a triangle and check whether triangle is valid or not
8) Write a C program to check whether a year is leap year or not.
9) Write a C program to input basic salary of an employee and calculate its Gross salary according to following: Basic Salary <= 10000 : HRA = 20%, DA = 80% Basic Salary <= 20000 : HRA = 25%, DA = 90% Basic Salary > 20000 : HRA = 30%, DA = 95%
10) Write a c program to print “welcome” 10 times.
11) Write a c program to print first n natural numbers using while loop.
12) Write a c program to print all the odd numbers in a given range.
13) Write a c program to add first n numbers using while loop.
14) Write a c program to print all numbers divisible by 3 or 5 in a given range.
15) Write a c program to add even numbers in a given range.
16) Write a c program to find the factorial of a given number.
17) Write a c program to find whether a number is prime or not.
18) Write a c program to print the reverse of a number.
19) Write a c program to add the digits of a number.
20) Write a c program to print the fibonacci series in a given range.
21) Write a c program to check whether a number is an Armstrong number or not.
22) Write a c program to find g.c.d. and l.c.m. of two numbers.

DIGITAL ELECTRONICS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Digital Electronics Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 1^{st}

List of practical:

1) Study of Logic Gates–AND, OR, NOT, NAND, NOR XOR (Using respective ICs)
2) Realization of basic gates using Universal logic gates.
3) Code conversion circuits- BCD to Excess-3 and vice-versa.
4) Design and implementation of odd and even parity checker Generator
5) Construction of simple arithmetic circuits-Adder, Subtractor.
6) Design and Realization of Adder/Subtractor using Universal Gates.
7) Construction of simple Decoder and Multiplexer circuits using logic gates.
8) Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
9) Realization of all flip-flops using Universal logic gates.
10) Implementation of Shift Registers using flip flops

SEMESTER-II

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Linear Algebra		MC	3	2	1	0
2	Functional Programming using C		MC	4	3	1	0
3	Computer Organization		MC	3	2	1	0
4	Signal and Systems		MC	3	2	1	0
5	Soft-Skill Development-II		NV	1	1	0	0
6	MDC1: Engineering Physics/ Electrical Engineering		MDC	4	3	1	0
7	Communicative English-II		AEC	2	2	0	0
8	Environmental Science-II		VAC	2	2	0	0
Practical							
9	Functional Programming using C Lab		MC	1	0	0	2
10	Computer Organization Lab		MC	1	0	0	2
11	Signals and Systems Lab		MC	1	0	0	2
Total Credit=25							

LINEAR ALGEBRA

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Linear Algebra	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

THEORY

Learning objectives: On completion of the course, student will be able to: apply the knowledge of calculus and differential equation to solve complex engineering problem.

Prerequisite: Before learning the concepts of Calculus and Differential Equation student should have a basic knowledge of set, function, limit, continuity etc

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Matrix, Determinant	8	22%
Module-II: Solutions of System of Linear Equations	6	17%
Module-III: Vector Space	6	17%
Module-IV: Linear Transform	6	17%
Module-V: Inner Product Space	8	22%
Module-VI: Applications	2	6%

SYLLABUS OUTLINE:

Module I: Matrix, Determinant: [8L]

Introduction to Matrices and Determinants, Inverse of a Matrix, Elementary operations, Echelon form, Row-reduced echelon form, Rank of a matrix. Symmetric and Skew-symmetric matrix, Orthogonal matrix, Hermitian and unitary matrices.

Module II: Solutions of System of Linear Equations: [6L]

Solution of System of Linear Equations; Cramer's rule, Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices.

Module III: Vector Space: [6L]

Definition of Vector space, Examples of vector space, Subspaces, linear dependence, Linear independence, Linear Span, Basis, Dimension.

Module IV: Linear Transform: [6L]

Linear transformations, Examples of Linear Transform (Rotation, Projection etc.), Matrix representation of Linear transform, Linear Operator, Eigenvalues and Eigenvectors.

Module V: Inner Product Space: [8L]

Inner Product Space, Orthogonality, Projections, Gram-Schmidt orthogonalization theorem and QR decomposition. Singular value decomposition.

Module VI: Applications: [2L]

Introduction to the applications of Linear Transform and inner product space in Image Processing and Machine Learning.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Linear Algebra: Stephen H. Freiedberg, Arnold J. Insel and Lorence E. Spence
2) Higher Algebra- S.K. Mapa

Reference Books:

1) Linear Algebra - Ghosh and Chakraborty
2) Linear Algebra – Hadley

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	1	1	-	-	-	-	-	-	1
CO5	2	3	-	1	1	-	-	-	-	-	-	-
CO6	3	3	3	1	1	-	-	-	-	-	-	1
Avg	2.83	2.5	0.5	0.5	0.5	-	-	-	-	-	-	0.5

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand the fundamental concepts of matrices and determinants.

CO2: To be able to solve systems of linear equations using various methods.

CO3: To be able to identify and analyse Vector Spaces.

CO4: To be able to apply Linear Transformations and Eigenvalue Analysis.

CO5: To be able to apply Inner Product Spaces and Decomposition Techniques in complex engineering problems.

CO6: To be able to apply concepts of Linear Algebra in Image Processing and Machine Learning.

FUNCTIONAL PROGRAMMING USING C

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Functional Programming using C	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

THEORY

Learning objectives: On completion of the course, student will be able to: acquire foundational programming skills in C, focusing on data structures, memory management, file handling, and basic algorithms for problem-solving.

Prerequisite: Fundamentals of Computer Science & Problem Solving

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Array and String	8	17%
Module-II: Function and Function Recursion	12	25%
Module-III: Pointers	10	21%
Module-IV: Structure, Union and Enum	8	16%
Module-V: File Handling	6	12%
Module-VI: Searching and Sorting	4	8%

SYLLABUS OUTLINE:

Module I: Array and String: [8L]

Array: Definition, declaration syntax, initialization, accessing elements of 1D, 2D, 3D arrays; row major & column major representations of arrays; sparse matrix: its implementation and usage; array representation of polynomials. Uses of arrays, Advantages and disadvantages of arrays.

Strings: Definition, declaration and initialization, memory representation of strings, reading and writing strings: Using scanf() and printf() functions, gets() and puts() functions, getchar() and putchar() functions; use of sscanf() and sprintf() functions, string handling library functions.

Module II: Function and Function Recursion: [12L]

Function: Definition, and purpose. Anatomy of a Function: Function Declaration, Definition, and Call; Syntax of Function Declaration, Definition and Call; Examples, Advantages of Using Functions, Types of Functions, Function naming conventions, return values and types, Parameter Passing Techniques: Call by value, Call by reference. Storage classes in functions: Automatic (auto) variables, external (extern) variables, static variables, register variables, Macro: Concept, Declaration, Types of macros, Predefined Macros, Macro vs. Function. Preprocessor Directives: Concept, Types.

Recursive Function: Definition and concept of recursion, Base case and recursive case Simple examples of recursive functions, Advantages and disadvantages of recursion, Recursion vs. iteration, Tail recursion.

Module III: Pointers: [10L]

Basic concept and Definition, declaration and initialization, Pointer operators: * and &; precedence of * and & operator, dereferencing of Pointer. Double pointers/ pointer to pointer, Pointer arithmetic: Incrementing and decrementing pointers. Concept of NULL Pointer, Wild pointer, Generic pointer, Dangling pointer. Pointers and arrays: Relationship between pointers and arrays, accessing array elements using pointers. Pointers and strings: Manipulating strings using pointers, common string functions with pointers. Dynamic memory allocation (DMA): malloc(), calloc(), realloc(), and free() functions. Pointers to pointers, applications of pointers to pointers. Usages of pointer, Advantages and Disadvantages of pointer.

Module IV: Structure, Union and Enum: [8L]

Structure: Definition, Features, declaration syntax, Declaring structure variables, Accessing members of structure, and importance of structures. Difference between Array and Structure. Nested structures, Arrays of structures (Declaring and initializing arrays of structures, accessing array elements). Pointers to structures. Self Referential Structure, typedef of Structure.

Union: Declaration Syntax, Declaring union variables, accessing union members, Memory Allocation of union, and purpose of unions, structures vs. unions.

Enum: Definition, declaring and defining enums, assigning values to enum members, Accessing and manipulating enum values and importance of enums.

Module V: File Handling: [6L]

I/O functions, File Pointer, File Operations: Opening & Closing a File, reading from and writing to files using fgetc(), fputc(), fgets(), fputs(), fread(), and fwrite(); Creation of a new file, Reading file contents, Append contents in a file, Copy one file content to another file, Compare two files, Rename & Delete a file.

Module VI: Searching and Sorting: [4L]

Searching: linear search, binary search. Sorting: Bubble sort, insertion sort, and selection sort.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie
2) "C Programming: A Modern Approach" by K. N. King
3) "Let Us C", Yashavant Kanetkar, BPB Publications, 17th ed, 2020.

Reference Books:

1) "C: A Reference Manual" by Samuel P. Harbison and Guy L. Steele
2) "Expert C Programming: Deep C Secrets" by Peter van der Linden

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	1	1	1	1	1	1
CO2	3	3	3	2	2	1	1	1	1	1	1	1
CO3	3	2	2	3	2	1	1	1	1	1	2	1
CO4	3	2	3	2	1	1	1	1	1	1	1	1
CO5	2	2	3	1	3	1	1	1	1	2	1	1
CO6	2	3	3	3	2	1	1	1	1	1	2	1
Avg	2.67	2.5	2.67	2	1.83	1	1	1	1	1.17	1.33	1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Students will be able to understand and apply the concepts of arrays and strings.

CO2: Able to define, declare, and implement functions and function recursion in C, understand different parameter passing techniques, and use various storage classes within functions.

CO3: Understand the basic concepts of pointers, including their declarations, initializations, operations, and perform dynamic memory allocation.

CO4: Able to define and use structures, unions, and enumerations in C.

CO5: Students will be proficient in performing file operations in C, including opening, closing, reading, writing, appending, and manipulating files.

CO6: Students will be able to implement basic searching algorithms and sorting algorithms.

COMPUTER ORGANIZATION

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Computer Organization	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

THEORY

Learning objectives: On completion of the course, student will be able to: Demonstrate computer organization concepts related to design of modern processors, memories and I/Os. Analyse the performance of commercially available computers. This course is intended to teach the basics involved in data representation and digital logic circuits used in the computer system.

Prerequisite: Before learning the concepts of Computer Organization, you should have a basic knowledge prior to Computer System Architecture, basic functional units of a computer system, Binary numbers etc

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Fundamental of Computer Organization	5	14%
Module-II: ALU Design	7	20%
Module-III: Computer Arithmetic	7	20%
Module-IV: Design of Control Unit	6	17%
Module-V: Memory	6	15%
Module-VI: Input-Output Organization	5	14%

SYLLABUS OUTLINE:

Module I: Fundamental of Computer Organization: [5L]

Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes.

Module II: ALU Design: [7L]

The ALU: ALU organization, Integer Representation, Serial and parallel Adders, 1'S and 2's Complement

Arithmetic, Multiplication of Signed binary numbers, Overflow detection, Status flags. Floating point - IEEE 754 standard. Fixed- and floating-point representation of numbers. Floating point number arithmetic, Design of ALU

Module III: Computer Arithmetic: [7L]

Overflow and underflow. Design of adders - ripple carry and carry look-ahead principles. Fixed point multiplication -Booth's algorithm. Fixed point division - Restoring and non-restoring algorithms

Module IV: Design of Control Unit: [6L]

Hardwired and micro- programmed design approaches, Case study - design of simple hypothetical CPU.

Module V: Memory: [6L]

Memory unit design with special emphasis on implementation of CPU-memory interfacing. Memory organization, static and dynamic memory, memory hierarchy, associative memory. Cache memory, Virtual memory. Data path design for read/write access.

Module VI: Input-Output Organization: [5L]

Input-Output Subsystems, I/O transfers - program controlled, interrupt driven and DMA, privileged and non- privileged instructions, software interrupts and exceptions, Programs and processes - role of interrupts in process state transitions.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy, Elsevier
2) Computer Organization, Carl Hamachar, Zvonco Vranesic and Safwat Zaky, McGraw Hill.
3) Computer Architecture and Organization, John P. Hayes, McGraw Hill.

Reference Books:

1) Computer Organization and Architecture: Designing for Performance, William Stallings, Pearson Education
2) Computer Systems Design and Architecture, Vincent P. Heuring and Harry F. Jordan, Pearson Education

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	-	-	-	-	-	-	-
CO2	-	3	2	2	-	-	-	-	-	-	-	-
CO3	2	3	1	1	-	-	-	-	-	-	-	-
CO4	2	3	3	-	3	-	-	-	-	-	-	-
CO5	1	1	3	3	1	-	-	-	-	-	-	-
CO6	2	1	1	2	-	-	-	-	-	-	-	-
Avg.	1.67	2.17	2.33	1.5	0.67	-	-	-	-	-	-	-

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the structure, function and characteristics of computer systems and understand the design of the various functional units and components of computers.

CO2: Design the arithmetic and Logic unit and understand the floating- and fixed-point number representation

CO3: Analyze the performance of ripple carry adder and carry look ahead adder and understand the multiplication and division algorithm

CO4: Identify the elements of control unit and design of control unit

CO5: Explain the function of each element of a memory hierarchy.

CO6: Understand the input output subsystem and analyze the role of interrupts in process state transition

SIGNAL AND SYSTEMS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Signal and Systems	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

THEORY

Learning objectives:

1) This gives the basics of Signals and Systems required for all Electrical Engineering related courses.
2) To understand the behaviour of signal in time and frequency domain
3) To understand the characteristics of LTI systems
4) This gives concepts of Signals and Systems and its analysis using different transform techniques

Prerequisite: Higher Secondary Mathematics: indices, exponentials, logarithms, basic calculus

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Basic Properties of Signal	6	16.66%
Module-II: Linear shift-invariant (LSI) systems	8	22.22%
Module-III: Transformation of LSI System	8	22.22%
Module-IV: Laplace and Z Transform	8	22.22%
Module-V: State-space analysis	6	16.66%

SYLLABUS OUTLINE:

Module I: Basic Properties of Signal: [6L]

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additively and homogeneity, shift-invariance, causality, stability, reliability.

Module II: Linear shift-invariant (LSI) systems: [8L]

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behaviour with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.

Module III: Transformation of LSI System: [8L]

Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases

Module IV: Laplace and Z Transform: [8L]

The Laplace Transform, notion of Eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

The z-Transform for discrete time signals and systems- Eigen functions, region of convergence, z-domain analysis

Module V: State-space analysis: [6L]

State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2) R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998
3) Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.

Reference Books:

1) B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
2) Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3										
CO2	1	2	3									
CO3	3		2		1							
CO4	1	3	2									
CO5	3	1	2									
CO6		2		1	3							
Avg.	1.67	1.83	1.5	0.17	0.67							

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Describe the basic mathematical operations on signals and systems

CO2: Convert the Analog signal into discrete time signal using sampling theorem

CO3: Explain the properties of Fourier series and transformations

CO4: Discuss the properties of Laplace and Z transformation

CO5: Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system

CO6: Compute the response of the LTI system for random inputs

SOFT-SKILL DEVELOPMENT-II

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Soft-Skill Development-II	**COURSE CREDIT:** 01[1-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: MVSSU122T02	**SEMESTER:** 2^{nd}

THEORY

Learning objectives: To understand the different aspects of communication using the four macro skills – LSRW (Listening, Speaking, Reading, Writing)

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Fundamentals of Communication		30%
Module-II: Verbal Communication		30%
Module-III: Non-Verbal Communication		20%
Module-IV: Listening Skills		10%
Module-V: Prose		10%

SYLLABUS OUTLINE:

Module I: Fundamentals of Communication: [L]

- Process & Importance
- Role and purpose of communication: 7 C's of Communication
- Effective Communication & Barriers
- Types & Channels
- Models of Communication (Linear & Shannon Weaver)
- Communication Networks

Activates: Daily conversation practice, pronunciation exercises, Listening comprehension, Cultural discussions

Module II: Verbal Communication: [L]

- Oral Communication: Forms, Advantages, Disadvantages
- Written Communication: Forms, Advantages & Disadvantages
- Introduction to Communication skills: Listening, Speaking, Reading, Writing

Activities: Debate discussion, public speaking challenges, Group presentations

Module III: Non-Verbal Communication: [L]

- Principles & Significance of Non-Verbal Communication
- KOPPACT (Kinesics, Oculesics, Proxemics, Para-Language, Artifacts, Chronemics, Tactilics)
- Visible Code/Object Language
- Haptics
- Body Language

Activities: Facial expression challenge, silent discussion, body language detective, Mirror exercise, Dumb-Charades

Module IV: Listening Skills: [L]

- Process, Importance and Types of Listening
- Effective Listening: Principles & Barriers

Activities: Dictation exercise, listen & sequence, listen & draw, note taking

Module V: Prose: [L]

- "Karma" by Khushwant Singh
- "Most Beautiful" by Ruskin Bond
- "The Last Question" by Isaac Asimov
- "The Fun They Had" by Isaac Asimov
- "An Astrologer's Day" by R.K. Narayan

- ***Pedagogy for Course Delivery:*** Extempore, Presentations
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	1	2
CO2	-	-	-	-	-	-	-	-	1	3	2	3
CO3	-	-	-	-	-	-	-	-	2	3	1	1
CO4	-	-	-	-	-	-	-	-	1	3	2	3
CO5	-	-	-	-	-	-	-	-	1	3	2	3
CO6	-	-	-	-	-	-	-	-	1	3	2	3
Avg.	-	-	-	-	-	-	-	-	1.17	3	1.67	2.5

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To develop clear and concise spoken communication skills for diverse contexts and audiences, enhancing overall verbal expression and clarity.

CO2: To master the use and interpretation of body language and non-verbal cues to communicate effectively and confidently.

CO3: To enhance active listening abilities, ensuring better comprehension and engagement in various situations through improved note-taking and attentiveness.

CO4: To improve the ability to comprehend and analyze complex written materials, fostering a deeper understanding and critical thinking skills.

CO5: To develop professional writing skills, enabling clear, persuasive, and effective written communication in various formal and informal contexts.

CO6: To cultivate a holistic approach to communication, integrating verbal, non-verbal, listening, and reading skills to excel in personal, academic, and professional interactions.

ENGINEERING PHYSICS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Engineering Physics	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MDC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

THEORY

Learning objectives:

1) To understand the basic concepts of oscillation
2) To understand the basic concepts and the applications of interference, diffraction and polarization of light, basic electromagnetism
3) To understand the basic concepts of quantum mechanics
4) Along with this, the course will enable students to learn about semiconductors, crystallography
5) To become familiar with the basic concepts and the applications of laser and fiber optics
6) To become familiar with laws of thermodynamics

Prerequisite: Basic Physics and Mathematics knowledge from 12^{th} Standard. Visualization and analytical approach towards the subject is necessary.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Oscillation	8	17%
Module-II: Interference-principle of superposition-young's experiment	8	17%
Module-III: Polarization of light	6	12%
Module-IV: Basic Idea of Electromagnetisms	6	12%
Module-V: Quantum Mechanics, Crystallography, Semiconductor Physics	12	25%
Module-VI: Laser and Fiber optics, Thermodynamics	8	17%

SYLLABUS OUTLINE:

Module I: Oscillation: [8L]

Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple spring mass system. Resonance-definition., damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators.

Module II: Interference-principle of superposition-young's experiment: [8L]

Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence.

Module III: Polarization of light: [6L]

Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

Module IV: Basic Idea of Electromagnetisms: [6L]

Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium.

Module V: Quantum Mechanics, Crystallography, Semiconductor Physics: [12L]

Quantum Mechanics: Introduction - Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box, Heisenberg Picture.

Crystallography: Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Atomic packing factor for SC, BCC, FCC and HCP structures.

Semiconductor Physics: Conductor, Semiconductor and Insulator; Basic concept of Band theory.

Module VI: Laser and Fiber optics, Thermodynamics: [8L]

Laser and Fiber optics: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering. Fiber optics and Applications, Types of optical fibers.

Thermodynamics: Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)

- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Concepts of Modern Physics, (Fifth Edition) A Beiser, McGraw Hill International.
2) Fundamentals of Physics, David Halliday, Robert Resnick and Jearl Walker, Wileyplus.

Reference Books:

1) Physics – I & II, Resnik & Halliday, Wily Eastern Ltd
2) Physics. Part – I & II NCERT
3) Applied Physics Arthur Beiser Tata McGraw- Hill
4) Physics - I V. Rajendram Tata McGraw- Hill Pub.
5) Engineering Physics Avadhanulu, Kshirsagar S. Chand Publication
6) Concept of Physics. Vol.- I & II H. C. Verma Bharati Bhavan Pub. & Distribution
7) B. Sc. Physics. Vol.- I & II C. L. Arora S. Chand & Co. Ltd.
8) Engineering Physics R. K. Gaur & S. L. Gupta Dhanpat Rai Pub.
9) Optics, (Fifth Edition) Ajoy Ghatak, Tata McGraw Hill.
10) Sears & Zemansky University Physics, Addison-Wesley
11) Fundamentals of Optics, (Third Edition) Jenkins and White, McGraw-Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	-	-	-	-	-	-	1
CO2	3	-	2	-	-	1	-	-	-	-	-	2
CO3	2	2	-	2	1	-	-	-	-	-	-	1
CO4	-	-	2	1	-	1	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	-
CO6	2	2	2	1	-	-	-	-	-	-	-	2
Avg	1.66	1.33	1.33	0.83	0.50	0.33	-	-	-	-	-	1.0

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Interpret oscillatory motion

CO2: Understand interference, diffraction and polarization phenomena of light. Explain basic concept of electromagnetism

CO3: Comprehend and explain the idea of quantum mechanics.

CO4: Understand the physics of semiconductor, crystallography.

CO5: Learn about laser and fiber optics

CO6: Analyze laws of thermodynamics and to distinguish different thermodynamic processes.

ELECTRICAL ENGINEERING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Electrical Engineering	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MDC
CODE: 1132113	**SEMESTER:** 2^{nd}

THEORY

Learning objectives:

Prerequisite:

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction		%
Module-II: DC Circuits		%
Module-III: AC Circuits		%
Module-IV: Electrostatics and Electro-Mechanics		%
Module-V: Measurements and Sensors		%
Module-VI: For Further Reading		%

SYLLABUS OUTLINE:

Module I: Introduction: [L]

Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

Module II: DC Circuits: [L]

Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.

Module III: AC Circuits: [L]

AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits

Module IV: Electrostatics and Electro-Mechanics: [L]

Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion

Module V: Measurements and Sensors: [L]

Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System & Wiring Accessories, Necessity of earthing, Types of earthing, Safety devices & system.

Module VI: For Further Reading: [L]

Principle of batteries, types, construction and application, Magnetic material and B-H Curve, Basic concept of indicating and integrating instruments

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Electric Machinery, (Sixth Edition) A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill.
2) A Textbook of Electrical Technology, (vol. I), B. L. Theraja, Chand and Company Ltd., New Delhi.
3) Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi
4) Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.

Reference Books:

1) Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press.
2) T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
3) Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press
4) Engineering Circuit Analysis, William H. Hayt & Jack E. Kemmerly, McGraw-Hill Book Company Inc
5) Fundamentals of Electrical and Electronics Engineering, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
Avg.												

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1:

CO2:

CO3:

CO4:

CO5:

CO6:

COMMUNICATIVE ENGLISH-II

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Communicative English-II	**COURSE CREDIT:** 02[2-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** AEC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

THEORY

Learning objectives: This course intends to acquaint the students with the communicative aspects of the English language in use today. The course hones their Listening, Speaking, Reading and Writing skills and makes them industry ready.

Prerequisite: Nil

Teaching-Learning Process (General Instructions):

These are sample strategies that teachers can use to accelerate the attainment of the various course outcomes.

1) Teachers shall adopt suitable pedagogy for an effective teaching-learning process. The pedagogy shall involve a combination of different methodologies that suit modern technological tools and software to meet the present requirements of the global employment market.

   i) Direct instructional method (Low/Old Technology)
   ii) Flipped classrooms (High/Advanced Technological Tools)
   iii) Blended learning (Combination of both)
   iv) Enquiry and evaluation-based learning
   v) Personalized learning
   vi) Problem-based learning through discussion
   vii) Following the method of expeditionary learning tools and techniques
   viii) Use of audio-visual methods through language labs in teaching of LSRW skills (Listening, Speaking, Reading, Writing)

2) Apart from conventional lecture methods, various types of innovative teaching techniques through videos and animation films may be adapted so that the delivered lessons can progress the students' theoretical, applied, and practical skills in teaching communicative skills in general.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Speaking Skill	8	33%
Module-II: Advance Reading Skills	8	33%
Module-III: Advanced Writing Skills	8	34%

SYLLABUS OUTLINE:

Module I: Introduction to Speaking Skill: [8L]
Speaking Skills, Group Discussion, Interview, Public Speaking

Module II: Advance Reading Skills: [8L]
Reading and Understanding Comprehension, Close Reading Analysis and Interpretation

Module III: Advanced Writing Skills: [8L]
Writing Skills, Advanced Grammar, Report Writing, Making Notes

- **Pedagogy for Course Delivery:** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- **Continuous Assessment:** Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

Text Books:

1) Communication Skills by Sanjay Kumar and Pushp Lata, Oxford University Press, 2019.
2) English for Engineers by N.P. Sudharshana and C. Savitha, Cambridge University Press, 2018.
3) A Textbook of English Language Communication Skills, Infinite Learning Solutions (Revised Edition), 2021.

Reference Books:

1) A Course in Technical English by D. Praveen Sam and K.N. Shoba, Cambridge University Press, 2020.
2) "Speak With Confidence: A Practical Guide" by Albert J. Vasile
3) English Language Communication Skills – Lab Manual cum Workbook, Cengage learning India Pvt Limited [Latest Revised Edition] – 2019.
4) Practical English Usage by Michael Swan, Oxford University Press – 2016.

5) Technical Communication – Principles and Practice, Third Edition by Meenakshi Raman and Sangeetha Sharma, Oxford University Press 2017.
6) "The Discussion Book: 50 Great Ways to Get People Talking" by Stephen D. Brookfield and Stephen Preskill

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	2	3
CO2	-	-	-	-	-	-	-	-	2	3	1	3
CO3	-	-	-	-	-	-	-	-	1	3	2	3
CO4	-	-	-	-	-	-	-	-	2	3	2	3
CO5	-	-	-	-	-	-	-	-	1	3	1	3
CO6	-	-	-	-	-	-	-	-	1	3	2	3
Avg.	-	-	-	-	-	-	-	-	1.33	3	1.66	3

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To acquaint students with the communicative aspects of contemporary English language use.

CO2: To hone listening, speaking, reading, and writing skills to prepare students for professional environments.

CO3: To develop interpersonal communication skills for effective interaction in diverse professional and social settings.

CO4: To equip students with critical thinking abilities through practical exercises.

CO5: To enhance problem-solving skills with real-world scenarios.

CO6: To improve overall English language proficiency for diverse applications.

FUNCTIONAL PROGRAMMING USING C LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Functional Programming using C Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

List of Practical:

1) Write a C program to create, initialize and use pointers.
2) Write a C program to add two numbers using pointers.
3) Write a C program to swap two numbers using pointers.
4) Write a C program to input and print array elements using pointer.
5) Write a C program to copy one array to other using pointers.
6) Write a C program to swap two arrays using pointers.
7) Write a C program to reverse an array using pointers.
8) Write a C program to search an element in array using pointers.
9) Write a C program to access two-dimensional array using pointers.
10) Write a C program to add two matrix using pointers.
11) Write a C program to multiply two matrix using pointers.
12) Write a C program to find length of string using pointers.
13) Write a C program to copy one string to other using pointers.
14) Write a C program to concatenate two strings using pointers.
15) Write a C program to compare two strings using pointers.
16) Write a C program to find reverse of a string using pointers.
17) Write a C program to implement the usages of malloc() and calloc().
18) Write a C program to return multiple values from function using pointers.
19) Write a C program to create a file and write contents, save and close the file.
20) Write a C program to read file contents and display on console.
21) Write a C program to read numbers from a file and write even, odd, prime numbers to another file.
22) Write a C program to append content to a file.
23) Write a C program to compare two files.
24) Write a C program to copy contents from one file to another file.
25) Write a C program to merge two file to third file.
26) Write a C program to count characters, words and lines in a text file.
27) Write a C program to remove a word from text file.
28) Write C programs to implement Bubble Sort, Selection Sort, Insertion Sort.

COMPUTER ORGANIZATION LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Computer Organization Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

List of Practical:

1) To design the circuit of half adder.
2) To design the circuit of full adder.
3) To design the circuit of half subtractor.
4) To design the circuit of full subtractor.
5) To design an 8×1 Multiplexer.
6) To design a 4 bit combinational shifter.
7) To design a BCD adder
8) To design a 4-bit adder subtractor.
9) To design 2:4 Decoder
10) To design an ALU.

SIGNALS AND SYSTEMS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Signals and Systems Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 2^{nd}

List of Practical:

1) Introduction to MATLAB: To define & use variables, vectors, Matrices & its functions in MATLAB. To study various arithmetic operators and mathematical functions in MATLAB. To create & use m-files.
2) Basic plotting of signals: To study various MATLAB commands for creating two- and three-dimensional plots.
3) Write a MATLAB program to plot the following continuous time and discrete time Signals.
4) Step Function
5) Impulse Function
6) Exponential Function iv. Ramp Function v. Sine Function
7) Write a MATLAB program to obtain linear convolution of the given sequences
8) Write a MATLAB program to perform amplitude-scaling, time-scaling and time-shifting on a given signal.
9) Write a MATLAB program to obtain Cross correlation of sequence $x(n)$ and $y(n)$ & autocorrelation of a sequence $x(n)$ of the given sequences & verify the property.
10) Write a MATLAB program to generate Fourier series of a Square Wave.
11) Write a MATLAB program to Calculate and plot using MATLAB Fourier Transform and Z-Transform of a given signal.
12) Write a MATLAB program to find the impulse response and step response of a system from its difference equation.
13) Compute and plot the response of a given system to a given input.
14) Write a MATLAB program to plot magnitude and phase response of a given system.
15) Checking linearity/non-linearity of a system using SIMULINK
16) Build a system that amplifies a sine wave by a factor of two.

SECOND YEAR

SEMESTER-III

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Data Structures		MC	4	3	1	0
2	Computer Architecture		MC	3	2	1	0
3	Formal Language and Automata Theory		MC	3	2	1	0
4	Object Oriented Programming with Java		MC	3	2	1	0
5	Numerical Methods and Programming/ Optimization Technique		ME	3	2	1	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-II		NV	1	0	0	2
7	Soft-Skill Development-III		NV	1	1	0	0
8	MDC II: Biology for Engineers		MDC	2	2	0	0
9	Foreign Language-I		AEC	2	2	0	0
Practical							
10	Data Structures Lab		MC	1	0	0	2
11	Computer Architecture Lab		MC	1	0	0	2
12	Object Oriented Programming with Java Lab		MC	1	0	0	2
13	Numerical Methods and Programming Lab/ Optimization Technique Lab		ME	1	0	0	2
Total Credit=26							

DATA STRUCTURES

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Data Structures	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives: On completion of the course, student will be able to Understand basic data structures and their implementation. Develop skills to apply appropriate data structures in problem solving.

Prerequisite: Fundamentals of Computer Science & Problem Solving

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Data Structure	6	12%
Module-II: Array, Stack and Queue	8	17%
Module-III: Linked List	6	12%
Module-IV: Trees	10	21%
Module-V: Graphs	8	17%
Module-VI: Searching, Sorting, and Hashing	10	21%

SYLLABUS OUTLINE:

Module I: Introduction to Data Structure: [4L]

Introduction: Requirement of data structure. Concepts of data structures: Data and data structure, Abstract Data Type and Data Type, Algorithms and programs, basic idea of pseudo-code, Basic concept of time complexity, Big-O notation, Common time complexities: $O(1), O(logn), O(n), O(nlogn), O(n^2), O(2^n), O(n!)$

Module II: Array, Stack and Queue: [10L]

Different representations: row major, column major. Sparse matrix: its implementation and usage, Array representation of polynomials. Stack and its implementations, applications: Polish notation.

Recursion: Principles of recursion– use of stack, differences between recursion and iteration, tail recursion, Applications - The Tower of Hanoi.

Queue, Circular Queue, Deque, Implementation of queue- both linear and circular.

Module III: Linked List: [8L]

Singly linked list, circular linked list, doubly linked list, linked implementation of Stack and Queue, linked list representation of polynomials and applications.

Module IV: Trees: [12L]

Binary trees - definition, binary tree traversal (pre-, in-, post- order), construction of binary tree from the traversals, binary tree representation (using array, using linked list), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only), B Trees operations (insertion, deletion with examples only), B+ Trees.

Module V: Graphs: [8L]

Definition and types of graphs, Terminologies, Representation of graphs: Adjacency matrix, Adjacency list. Graph Traversal Techniques: Breadth-First Search (BFS), Depth-First Search (DFS), Topological sort.

Module VI: Searching, Sorting, and Hashing: [10L]

Sorting Algorithms: Bubble sort, insertion sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application– priority queue), Radix sort, Shell sort. Searching: linear search, binary search, interpolation. Hashing: Definition and purpose of hashing, Overview of hash functions, Hashing Methods: Open Addressing, Chaining. Open Addressing Techniques: Linear Probing, Quadratic Probing, Double Hashing. Collision, Collision resolution techniques, Load factor (λ).

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed. Fundamentals of Data Structures in C (2nd ed.). Universities Press, 2008.
2) Yashavant Kanetkar. Data Structures Through C (2nd ed.). BPB Publications, 2019.
3) Fundamentals of Data Structures in C, E.Horowitz- S.Sahni, Galgotia-2006
4) Data Structures and Algorithm Analysis in C, M.A.Weiss, Pearson Education-Fourth Edition

Reference Books:

1) Data Structures, Algorithms and Applications in C, Sartaj Sahni, University Press
2) Data Structures using C by Yedidyah Langsam, Moshe J. Augenstein and Aron M. Tananbaum, PHI.2002

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	3	3	1								1
CO3	3	3	3	2								1
CO4	3	3	3	1								1
CO5	3	3	3	2								1
CO6	3	3	3	2								1
Avg.	3	2.83	2.67	1.33								0.83

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Student will understand the fundamental concepts of data structures and algorithms, time complexities, and apply Big-O notation to evaluate algorithm efficiency.

CO2: Analyze and implement arrays, stacks, and queues using different representations and data structures.

CO3: Demonstrate an understanding of linked lists, including singly, doubly, and circular linked lists, and apply these structures for polynomial representation and other real-world applications.

CO4: Gain proficiency in binary trees and their traversals, and understand advanced tree structures like AVL trees, Red-Black trees, B-trees, and B+ trees, using these concepts to solve search and insertion operations.

CO5: Apply graph theory concepts such as graph traversal techniques, minimum spanning trees, and algorithms like Kruskal's and Prim's to solve connectivity and path finding problems in various applications.

CO6: Implement and analyze searching, sorting, and hashing techniques, including various sorting algorithms and hashing methods.

COMPUTER ARCHITECTURE

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Computer Architecture	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives: Students will be able to conceptualize the basics of organizational and architectural issues of a digital computer, Classify and compute the performance of machines, Machine Instructions. They will be able to learn about various data transfer techniques in digital computer and the I/O interfaces. The students will be able to estimate the performance of various classes of Memories, build large memories using small memories for better performance and Relate to arithmetic for ALU implementation. They will be able to understand the basics of hardwired and micro-programmed control of the CPU, pipelined architectures, Hazards and Superscalar Operations.

Prerequisite: Computer Organization, Digital Logic, Machine Instructions, Dataflow.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	3	7%
Module-II: Pipelining	8	12%
Module-III: Memory Organization	6	20%
Module-IV: Instruction-Level Parallelism	7	18%
Module-V: Multiprocessor Architecture	8	25%
Module-VI: Non Von Neumann Architecture	4	18%

SYLLABUS OUTLINE:

Module I: Introduction: [3L]

Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance.

Module II: Pipelining: [8L]

Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural

hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques; Compiler techniques for improving performance.

Module III: Memory Organization: [6L]

Revisiting Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache coherence problem; Virtual memory organization, mapping and management techniques, memory replacement policies, interleaved memory organization, C access, S access, CS access

Module IV: Instruction-Level Parallelism: [7L]

Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super-pipelined and VLIW processor architectures. Array and vector processors.

Module V: Multiprocessor Architecture: [8L]

Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared- memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Cluster computers.

Module VI: Non Von Neumann Architecture: [4L]

Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman, 2011.
2) V. Carl, G. Zvonko and S. G. Zaky, “Computer organization”, McGraw Hill, 1978.
3) Computer Organization and Architecture: Designing for Performance, William Stallings, Pearson Education.
4) Computer Systems Design and Architecture, Vincent P. Heuring and Harry F. Jordan, Pearson Education.
5) B. Brey and C. R. Sarma, “The Intel microprocessors”, Pearson Education, 2000.

Reference Books:

1) Rajaraman – "Computer Organization & Architecture", PHI
2) B.Ram – "Computer Organization & Architecture", Newage Publications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2								
CO2	3	2	1	2		1						1
CO3	2		2	2								1
CO4	3	1	2	1								1
CO5	2			2								
CO6	2		2	2		1						1
Avg.	2.5	1.66667	1.6	1.83333		0.33						0.67

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the concepts of pipelining and parallel processing.

CO2: Design arithmetic and instruction pipeline and be able to solve the problems of pipeline hazards.

CO3: Understand the interleaved memory organization and concurrent and simultaneous memory access and analysis the cache coherence problem.

CO4: Understand the techniques for designing superscalar and super-pipelined architecture.

CO5: Understand the concepts of multiprocessor architectures.

CO6: Understand the concepts of non-von Neumann architectures like dataflow computer, systolic architecture etc.

FORMAL LANGUAGE AND AUTOMATA THEORY

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Formal Language and Automata Theory	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives: This course focuses on the basic theory of Computer Science and formal methods of computation like automata theory, formal languages, grammars and Turing Machines. The objective of this course is to explore the theoretical foundations of computer science from the perspective of formal languages and classify machines by their power to recognize languages.

Prerequisite: The primary prerequisite for this course is reasonable "mathematical sophistication." The basic mathematical notations are required to know. The logical functional principles of machine are also need to know. Sets & Types, Sequences, Tuples, Propositional and Predicate Logic, Mathematical Induction, Recursive Definitions, Big-O Notation, Relations and Functions.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Finite Automata	10	27%
Module-II: Regular Languages and Regular Grammars	6	17%
Module-III: Context-Free Languages	6	17%
Module-IV: Linear Bounded Automata and Turing Machine	6	17%
Module-V: Recursive language and Recursively Enumerable language	4	11%
Module-VI: Computational Complexity	4	11%

SYLLABUS OUTLINE:

Module I: Finite Automata: [10L]

Introduction, Finite state machine (FSM), state table & state assignments, Finite Automata, Types of Finite Automata: DFA, NFA, $\varepsilon-$NFA; DFA: mathematical representation, transition diagram & table, Construction of DFA, DFA Minimization, complement of DFA. NFA: mathematical representation, tran-

sition diagram & table, Construction of NFA, Conversion of NFA to DFA, complement of NFA; $\varepsilon-$NFA: mathematical representation, Construction of $\varepsilon-$NFA, Conversion of $\varepsilon-$NFA to NFA.

Moore Machine and Mealy Machine: Mathematical, diagramatical and tabular Representation of Moore Machine and Mealy Machine, Construction of more Machine and Mealy machine, Transformation of a Moore M/C to Mealy M/C and vice versa.

Module II: Regular Languages and Regular Grammars: [6L]
Classification of grammar, Regular Expressions, Regular Grammars, Regular Expressions to Finite Automata, Finite Automata to Regular Expressions, Properties of Regular Languages, Identifying regular and Non-regular Languages.

Module III: Context-Free Languages: [6L]
Definition of Context-Free Grammars (CFG), Examples of Context-Free Languages Leftmost and Rightmost Derivations, Derivation Trees, Relation Between Sentential Forms and Derivation Trees,, Ambiguity in Grammars and Languages, CFG Simplification, Chomsky Normal Form (CNF), conversion of CFG to CNF, Greibach Normal Form (GNF), Pushdown Automata (PDA): Definition, Language Accepted by PDA, Pumping Lemma.

Module IV: Linear Bounded Automata and Turing Machine: [6L]
Linear Bounded Automata: Concept of Context-sensitive, Closure properties of Context-sensitive Language. Turing Machine: Introduction and basic concepts, Representation of Turing Machine, Design of Turing Machine, Linear bounded automata, and languages.

Module V: Recursive language and Recursively Enumerable language: [4L]
Recursive Language (REC), Recursively Enumerable Language (RE), Turing Machine Halting Problem, Decidable and undecidable languages: Decidable languages, Undecidabile languages.

Module VI: Computational Complexity [4L]
Types of Complexity Classes: P, NP, NP hard and NP complete; Features and examples of P, NP, NP hard and NP complete.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Hopcroft and Ullman, "Introduction to Automata Theory, Languages and Computation", 2nd edition, Pearson/Prentice Hall India, 2007.
2) Martin J. C., "Introduction to Languages and Theory of Computations", 2nd edition, Tata McGraw Hill, 2005.

Reference Books:

1) K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", 2nd edition, Pearson/Prentice Hall India, 2004.
2) Papadimitrou, C. and Lewis, C.L., "Elements of the Theory of Computation", 2nd edition, Pearson/Prentice Hall India, 2009.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	-	2	-	1
CO2	3	3	3	3	2	-	-	-	-	2	-	1
CO3	3	3	2	2	2	-	-	-	-	2	-	1
CO4	3	3	3	3	2	-	-	-	2	2	-	1
CO5	3	3	3	2	2	-	-	-	-	2	-	1
CO6	3	3	3	2	2	-	-	-	-	2	2	1
Avg	3	3	2.83	2.33	2	-	-	-	0.33	2	0.33	1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the foundational concepts of Finite Automata and their applications.

CO2: Develop skills to work with regular expressions and regular languages, identifying regular and non-regular languages.

CO3: Analyze and simplify context-free grammars and understand derivations, parse trees, and ambiguity.

CO4: Design Turing machines and Linear Bounded Automata for solving computational problems.

CO5: Understand recursive and recursively enumerable languages, and the decidability and undecidability of languages.

CO6: Comprehend computational complexity theory and analyze the complexity classes P, NP, NP-hard, and NP-complete.

OBJECT ORIENTED PROGRAMMING WITH JAVA

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Object Oriented Programming with Java	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives:

1) To impart the core language features of Java and its Application Programming Interfaces.
2) To demonstrate the use of threads, exceptions, files and collection frameworks in Java.
3) To familiarize students with GUI based application development and database connectivity.

Prerequisite: Fundamentals of Computer Science and Problem Solving

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Java Basics	4	11%
Module-II: Java Array, String, and Exception Handling	8	22%
Module-III: Inheritance, Abstraction, Encapsulation and Polymorphism	10	28%
Module-IV: Packages and Interfaces	4	11%
Module-V: Multithreading	4	11%
Module-VI: Applet and Servlet	6	17%

SYLLABUS OUTLINE:

Module I: Java Basics: [4L]

Concept of Object Oriented Programming (OOPs), Properties of OOPs (Object, Class, Inheritance, Abstraction, Encapsulation, Polymorphism), Concept of JVM, JRE, JDK; Features of java, Constants, Variables, Data Types, Type Conversion and Type Casting; Operators, Decision making and Branching, Loops. Simple Java Program: compilation, execution, Java Class declaration and Object creation, the byte code.Java Methods, Java Constructor, Java Access Modifiers and Non-Access Modifiers.

Module II: Java Array, String, and Exception Handling: [8L]

Array: Declaration, initialization, and accessing array elements of single-dimensional and multi-dimensional arrays.Traversing arrays using loops.Common array operations: insertion, deletion, searching, and sorting.

String: Creating string, String arrays, String methods, Immutable String, StringBuffer class.

Exception Handling: Error-Concept of error, types of errors, Exceptions-Syntax of exceptions handling, exception hierarchy, types of exception,usage of exception handling keywords: try, catch, throw, throws, final, finally and finalize, Advantages of Exception Handling.

Module III: Inheritance, Abstraction, Encapsulation and Polymorphism: [10L]

Inheritance: Concept of Inheritance, Why use Inheritance, Types of inheritance, uses of super, static and final keyword.

Abstraction: Concrete class, Abstract Class, Abstract Methods,Interface: Why we use Interface? Properties of Interface. Similarity and Dissimilarity between interface and class. Difference between abstract class and interface. **Encapsulation:** Concept of Encapsulation, Advantages of Encapsulation. **Polymorphism:** Compile Time Polymorphism and Runtime Polymorphism

Module IV: Packages and Interfaces : [4L]

Defining, Creating and Accessing a Package, Java package hierarchy, built-in package and user-defined package, subpackage in java, Advantages of Java Package.

Module V: Multithreading: [4L]

Concept of thread, Life cycle of a Thread, Creating Thread, Thread Scheduling, Thread Priority, daemon threads, Advantages Multithreading in Java.

Module VI: Applet and Servlet: [6L]

Applet: Hierarchy of Applet, Lifecycle of an Applet, Running an Applet program: Run Applet by appletviewer tool, Run Applet by html file; Lines, Rectangles, and Triangles Drawing using Applet class method. **Servlet:** Introduction to servlet, Servlet Life Cycle, Servlet Architecture, How servlet works?.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Herbert Schildt, The Complete Reference -Java, Tata McGraw-Hill Education, Tenth Edition, 2017.

2) Programming with JAVA 5th Edition By Balagurusamy, Tata McGraw-Hill Education, Fifth Edition.

Reference Books:

1) Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition, 2011.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	-	-	-	2	2	-	1
CO2	3	3	3	2	3	-	-	-	2	2	-	1
CO3	3	3	3	3	3	-	-	-	2	2	-	1
CO4	3	3	3	3	3	-	-	-	2	2	-	1
CO5	3	3	3	2	3	-	-	-	2	2	-	1
CO6	3	3	3	2	3	-	-	-	2	2	-	1
Avg	3	3	3	2.33	3	-	-	-	2	2	-	1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand and apply the fundamental concepts of Object-Oriented Programming (OOPs) in Java, including class, object, inheritance, polymorphism, and control structures to write basic Java programs.

CO2: To be able to manipulate arrays and strings efficiently and implement robust Java programs using exception handling techniques to manage errors.

CO3: To be able to demonstrate the use of inheritance, abstraction, encapsulation, and polymorphism to create flexible and reusable Java code.

CO4: To able to organize Java programs using packages and interfaces to promote code modularity and reuse.

CO5: To be able to implement multithreading in Java to create efficient programs that can perform multiple tasks concurrently.

CO6: To be able to develop and deploy Java applets and servlets, understanding their life cycles and how they can be used to create interactive web applications.

NUMERICAL METHODS AND PROGRAMMING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Numerical Methods and Programming	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives: On completion of the course, students will be able to solve complicated mathematical problems and real life problems numerically. Also, they can apply MATLAB and other convenient numerical software such as Microsoft Excel to solve numerical problems with the help of simple programming.

Prerequisite: Before learning the course the learner should have a basic knowledge about integration, differentiation, real number system, system of equations, linear algebra.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Error of numerical computations	4	11%
Module-II: Interpolation	8	22%
Module-III: Numerical integration	6	17%
Module-IV: Numerical solution of non-linear equations	6	17%
Module-V: Numerical solution of a system of linear equations	6	17%
Module-VI: Numerical solution or Ordinary Differential Equation	6	16%

SYLLABUS OUTLINE:

Module I: Error of numerical computations: [4L]

Errors in Numerical computation: Round off error, Truncation error. Approximate numbers. Significant figures. Absolute, relative and percentage error. Operators: Δ, E, μ, δ (Definitions and simple relations among them).

Module II: Interpolation: [8L]

Problems of interpolation, Weierstrass' approximation theorem only statement). Polynomial interpolation. Equi-spaced arguments. Difference table. Deduction of Newton's forward and backward interpolation formulae. Statements of Stirling's and Bessel's interpolation formulae. Error terms. Deduction of Lagrange's interpolation formula. Divided difference. Newton's General Interpolation formula (only statement).

Module III: Numerical integration: [6L]

Integration of Newton's interpolation formula. Newton-Cote's formula. Trapezoidal and Simpson's $\frac{1}{3}$ rd formulae. Their composite forms. Weddle's rule (only statement). Statement of the error terms associated with these formulae. Degree of precision (only definition).

Module IV: Numerical solution of non-linear equations: [6L]

Location of a real root by tabular method. Bisection method. Secant/ Regula-Falsi and Newton-Raphson methods, their geometrical significance. Fixed point iteration method.

Module V: Numerical solution of a system of linear equations: [6L]

Gauss elimination method. Iterative method – Gauss-Seidal method. Matrix inversion by Gauss elimination method (only problems – up to 3×3 order), LU decomposition method.

Module VI: Numerical solution or Ordinary Differential Equation: [6L]

Basic ideas, nature of the problem. Picard, Euler and Runge-Kutta(4thorder) methods (emphasis on the problem only).

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2) Sahajahan Ali Mollah, Numerical Analysis and Computational Procedures, Books & Allied Ltd.
3) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
4) C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
5) Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
6) John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

Reference Books:

1) Scarborough, James B., Numerical Mathematical Analysis, Oxford and IBH publishing co.
2) Atkinson, K. E., An Introduction to Numerical Analysis, John Wiley and Sons, 1978. Yashavant Kanetkar, Let Us C, BPB Publications.
3) P. S. Grover, Programming and Computing with FORTRAN 77/90 – (Allied Publishers).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	1	2	1	-	1	-	1	1
CO2	3	2	1	2	1	1	1	1	2	-	1	1
CO3	3	2	1	2	1	1	-	-	1	-	1	1
CO4	3	2	1	2	1	1	-	-	-	-	1	1
CO5	3	2	1	2	1	1	-	-	-	-	1	1
CO6	3	2	1	3	1	1	-	-	1	2	1	1
Avg	3	2.17	1	2.33	1	1.17	0.33	0.17	0.83	0.33	1	1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to analyse the several errors and approximation in numerical methods.

CO2: To be able to construct the interpolating polynomial for both equispaced and un-equispaced arguments.

CO3: To be able to apply numerical integration techniques to solve complex problems.

CO4: To be able to understand and solve the system of linear and non-linear equations using different numerical techniques.

CO5: To be able to solve algebraic and transcendental equations using numerical methods.

CO6: To be able to construct numerical solution (local) of different initial value and boundary value problems.

OPTIMIZATION TECHNIQUES

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Optimization Techniques	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives: On completion of the course, student will be able to apply the knowledge of linear programming problem, queuing theory, inventory control to solve complex engineering problems.

Prerequisite: Before learning the concepts of Optimization Techniques, you should have a basic knowledge of set, vector space, probability theory.

Course content/ Syllabus table:

Module No.	No of lecture / Contact hour	Weightage (%)
Module-I: Introduction to OR	2	5%
Module-II: Linear Programming	8	22%
Module-III: Transportation	6	17%
Module-IV: Assignment problems	6	17%
Module-V: PERT – CPM	6	17%
Module-VI: Queuing Theory	8	22%

SYLLABUS OUTLINE:

Module I: Introduction to Operations Research: [2L]

Origin of Operations Research (OR) and its definition. Types of OR problems, problem formulation, building mathematical model, deriving solutions.

Module II: Linear Programming: [8L]

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP. Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence /Dependence of vectors, Rank, Basis, System of linear eqns., Hyper plane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions. Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & degeneracy, Sensitivity analysis. Simplex Algorithm –

slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations. Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

Module III: Transportation: [6L]

TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.

Module IV: Assignment problems: [6L]

AP - Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.

Module V: PERT – CPM: [6L]

Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

Module VI: Queuing Theory: [8L]

Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline)of queuing system, queue types (channel vs. phase).Kendall's notation, Little's law, steady state behavior, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Operations Research: An Introduction. H.A. Taha.

Reference Books:

1) Linear Programming. K.G. Murthy
2) Linear Programming. G. Hadley
3) Principles of OR with Application to Managerial Decisions. H.M. Wagner.
4) Introduction to Operations Research. F.S. Hiller and G.J. Lieberman.

5) Elements of Queuing Theory. Thomas L. Saaty.
6) Operations Research and Management Science, Hand Book: Edited By A. Ravi Ravindran.
7) Management Guide to PERT/CPM. Wiest & Levy.
8) Modern Inventory Management. J.W. Prichard and R.H. Eagle.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	-	-	-	-	-	-	1
CO2	3	3	1	-	-	-	-	-	-	-	-	1
CO3	3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	-	1	1	1	-	-	-	-	-	-	-
CO5	3	-	1	1	1	-	-	-	-	-	-	1
CO6	2	3	1	1	1	-	-	-	-	-	-	1
Avg.	2.83	1.5	1	0.67	0.5	-	-	-	-	-	-	0.67

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the concept of Operations Research and the basic concepts linear algebra.

CO2: Formulate Mathematical Model of various optimization problems and solve linear programming problems using appropriate techniques.

CO3: Determine optimal strategy for Transportation and Assignment problems.

CO4: Determine the critical path, project time and its variance using the project scheduling techniques – Gantt chart, PERT & CPM.

CO5: Understand the concept of inventory costs, Basics of inventory policy and fixed order-quantity models like EOQ, POQ.

CO6: Understand the concept of queuing theory and identify the queuing models like $M/M/1$ and $M/M/m$.

SOFT-SKILL DEVELOPMENT-III

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Soft-Skill Development-III	**COURSE CREDIT:** 01[1-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: MVSSU122T03	**SEMESTER:** 3^{rd}

THEORY

Learning objectives: To develop logical reasoning skills for effective problem-solving and decision-making. To master the principles and techniques of clear and impactful written communication. To cultivate professional skills essential for success in various professional environments.

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Logic & Analytics		20%
Module-II: Quantitative Aptitude		20%
Module-III: Reasoning Skills		20%
Module-IV: Mastering MS Office		30%
Module-V: Professional Skills		10%

SYLLABUS OUTLINE:

Module I: Logic & Analytics: [L]

- Blood Relation
- Direction Sense
- Seating Arrangement
- Syllogism
- Binary Logic & Data Caselets

Module II: Quantitative Aptitude: [L]

- Basic Maths – Vedic, shortcut tricks
- Classification of Numbers

- HCF & LCM
- Factors & Factorial
- Average, Ratio, and Proportion
- Time – Work & Time-speed
- Boats & Streams

Module III: Reasoning Skills: [L]

- Data Sufficiency
- Cause & Effect
- Course of Action
- Decision Making

Module IV: Mastering MS Office: [L]

- MS Word
- MS Excel
- MS PowerPoint

Module V: Professional Skills: [L]

- Critical Thinking
- Problem Solving
- Leadership
- Work Ethics

- ***Pedagogy for Course Delivery:*** Extempore, Presentations
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	1	3
CO2	-	-	-	-	-	-	-	-	1	1	2	2
CO3	-	-	-	-	-	-	-	-	2	3	2	3
CO4	-	-	-	-	-	-	-	-	2	2	2	3
CO5	-	-	-	-	-	-	-	-	2	2	2	3
CO6	-	-	-	-	-	-	-	-	2	2	1	3
Avg.	-	-	-	-	-	-	-	-	1.67	2.17	1.67	2.83

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To develop logical reasoning skills to enhance problem-solving and decision-making abilities in various contexts.

CO2: To master principles and techniques for clear, concise, and impactful written communication.

CO3: To cultivate essential professional skills for success in diverse professional environments.

CO4: To master workplace etiquette to navigate professional settings with confidence and respect.

CO5: To enhance networking abilities to build and maintain valuable professional relationships.

CO6: To develop strategies for effective career development, including goal-setting, planning, and continuous improvement.

BIOLOGY FOR ENGINEERS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Biology for Engineers	**COURSE CREDIT:** 02[2-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** MDC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

THEORY

Learning objectives:

1) Understand the fundamental principles of biology and their relationship to engineering and technology.
2) Explore biological classification, cellular structures, and biomolecular components essential for living systems.
3) Develop insights into biological processes like information transfer and enzymatic reactions.
4) Apply concepts such as biomimicry in engineering design and problem-solving.

Prerequisite: Basic understanding of high school-level biology and chemistry concepts.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Biology	3	12%
Module-II: Biological Classification	5	21%
Module-III: Cell Biology	5	21%
Module-IV: Biomolecules & Biomacromolecules	4	17%
Module-V: Enzymes	4	17%
Module-VI: Information Transfer	3	12%

SYLLABUS OUTLINE:

Module I: Introduction to Biology: [3L]

Science & Engineering; Biology; Biology and Engineering; Application of Biology; Engineering design inspired by examples in biology/Bio mimicry.

Module II: Biological Classification: [5L]

Biological Classification or Taxonomy; Types of Classification System; Taxonomic Hierarchy; Types of

Classification; Phylogenetic Tree; Level of Ecological Organization; Complexity of Cell; Ultra Structure of Cell; Energy and Carbon Utilization; Excretion and Metabolic Waste; Habitat; Model Organisms for the Study of Biology from Different Groups.

Module III: Cell Biology: [5L]

Cell and Cell Theory; Different Shapes of Cell; Prokaryotic Cell and Eukaryotic Cell; Plant Cell and Animal Cell. Cell Membrane; Cell Wall; Cellular Organelles; Aging; Cell Division; Cancer Biology.

Module IV: Biomolecules & Biomacromolecules: [4L]

Molecules of Life; Carbohydrates: Simple and Complex Sugar; Amino Acids and Proteins; Nucleotides and DNA/RNA; Fatty Acids, Glycerol and Lipids.

Module V: Enzymes: [4L]

Enzymology and Enzymes; Characteristics (Properties of Enzymes); Cofactors; Mechanism of Enzyme Reaction; Factors that Affect Activity of Enzyme; Enzyme Nomenclature; Ribozymes.

Module VI: Information Transfer: [3L]

Central Dogma of Life, Genetic code, Replication, Transcription, Translation

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) "Biology for Engineers" by Dr. Sandhimita Mondal and Dr. Arnab Ganguli
2) "Biology for Engineers", by G. K. Suraishkumar

Reference Books:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M. W.H. Freeman and Company.
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W. H. Freeman and Company, Distributed by Satish Kumar Jain for CBS Publisher.
5) Microbiology, Prescott, L.M, J.P. Harley and C.A. Klein 1995. 2nd edition Wm. C. Brown Publishers.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	3	3	2	-	2	-	2
CO2	3	3	2	2	-	2	2	-	-	-	-	2
CO3	3	2	3	2	-	3	2	-	-	-	-	2
CO4	3	3	3	3	2	3	3	-	-	-	-	2
CO5	2	3	2	3	3	3	2	-	-	-	-	2
CO6	3	3	3	3	3	3	3	-	-	2	-	3
Avg.	3	2.7	2.7	2.5	2	2.8	2.5	0.33	-	0.67	-	2.2

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Analyze biological concepts and identify how they inspire innovative solutions in engineering through biomimicry.

CO2: Classify living organisms and explain their ecological roles and cellular complexities.

CO3: Differentiate between cell types and describe cellular components and their functions in biological processes.

CO4: Illustrate the structures and functions of key biomolecules such as carbohydrates, proteins, lipids, and nucleic acids.

CO5: Explain the properties and mechanisms of enzymatic reactions and factors influencing enzyme activity.

CO6: Describe the flow of genetic information from DNA to proteins and its regulation in living organisms.

DATA STRUCTURES LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Data Structures Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

List of Practical:

1) Implement a stack by using array then do the PUSH & POP operation
2) Write a program to evaluate a postfix notation.
3) Write a program to convert infix to postfix.
4) Implement a Circular Queue by using array then do the enqueue and dqueue operation.
5) Implement Single Linked List and does insertion, deletion, display, reverse.
6) Implement Doubly Linked List and does insertion, deletion, display, reverse.
7) Implement a stack using linked lists.
8) Implement Circular Linked List, queue using linked lists.
9) Implement JOSEPHUS problem.
10) Write a program to add two polynomials.
11) Write a program to multiply two polynomials.
12) Write a program for addition of sparse matrix.
13) Write a program to multiplication of sparse matrix.
14) Create binary search tree and implement Preorder, Inorder, Postorder and delete an element from the tree
15) Implement a threaded binary tree and perform the inorder traversal operation.
16) Implement AVL tree.
17) Implement Splay tree.
18) Implement Priority Queue using Heap.
19) Implement BFS, DFS.
20) Implement Prim's and Kruskal's Algorithm.
21) Write a program to sort an array using Bubble sort.
22) Write a program to sort an array using Insertion sort
23) Write a program to sort an array using Selection sort.
24) Write a program to sort an array using Quick sort.
25) Write a program to sort an array using Merge sort.
26) Write a program to sort an array using Heap sort.
27) Write a program to sort an array using Radix sort.

28) Write a program to sort an array using Shell sort.

29) Implement Linear and Binary search.

30) Implement interpolation search

COMPUTER ARCHITECTURE LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Computer Architecture Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

List of practical:

Simulation of simple fundamental units like

- Half adder,
- Full adder,
- Multiplexer,
- De-multiplexer,
- Arithmetic logic Unit,
- Simple processor (CPU) etc using VHDL code. (Using Xilinx)

OBJECT ORIENTED PROGRAMMING WITH JAVA LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Object Oriented Programming with Java Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 3^{rd}

List of Practical:

1) Write a program to demonstrate the use of multidimensional arrays and looping constructs.
2) Write a program to demonstrate the application of String handling functions.
3) Write a program to demonstrate the use of Inheritance.
4) Write a program to demonstrate the application of user-defined packages and sub-packages.
5) Write a program to demonstrate the use of Java Exception handling methods.
6) Write a program to demonstrate the use of threads in Java. 2 hours
7) Demonstrate with a program the use of File handling methods in Java. 2 hours
8) Demonstrate the use of Java collection frameworks in reducing application development time.
9) Build a GUI application using JavaFX.
10) Write a program to register students data using JDBC with MySQL Database.
11) Write a program that uses Servlets to perform basic banking tasks.
12) Write a web application using JSP and demonstrate the use of http request and response methods.
13) Write a JSP program for an order management system.
14) Write a JSP program that using JDBC and MySQL database to store the user data.
15) JSP with Java Bean

NUMERICAL METHODS AND PROGRAMMING LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Numerical Methods and Programming Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 3^{rd}

List of Practical:

1) Evaluation of numerical integrations using
   (a) Trapezoidal Rule
   (b) Simpson's one-third rule
2) Solution of transcendental and algebraic equations by
   a) Bisection Method
   b) Regula-Falsi Method
   c) Newton Raphson's method
3) Solution of system of linear equations by
   a) Gauss-elimination method
   b) Gauss-Seidel iteration method
4) Interpolation: Lagrange Interpolation
5) Solution of Initial value problems using
   a) Euler's method
   b) RK4 method

OPTIMIZATION TECHNIQUE LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Optimization Technique Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 3^{rd}

List of Practical:

1) Linear Programming (Tranportation , Assignment , Duality , Simplex)
2) Shortest Path(Dijkstra's , Floyd's Algorithm)
3) Maximal Flow.
4) Queuing Theory
5) PERT/CPM
6) Integer Programming Problem (Branch & Bound Problem)

SEMESTER-IV

Sl No	Course Title	Code	Category	Credit	Type		
					L	T	P
1	Operating Systems		MC	4	3	1	0
2	Database Management System		MC	4	3	1	0
3	Artificial Intelligence		MC	3	2	1	0
4	Design and Analysis of Algorithms		MC	4	3	1	0
5	Soft-Skill Development-IV		NV	1	1	0	0
6	SEC1: Advanced Programming Techniques with R and Python		SEC	3	1	0	4
7	Foreign Language-II		AEC	2	2	0	0
Practical							
8	Operating Systems Lab		MC	1	0	0	2
9	Database Management System Lab		MC	1	0	0	2
10	Artificial Intelligence Lab		MC	1	0	0	2
				Total Credit=24			

OPERATING SYSTEMS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Operating Systems	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

THEORY

Learning objectives: The objective of this course is to

1) Comprehend the basic functions, services, and types of operating systems.
2) Analyze Process Management Techniques and Process Scheduling algorithms.
3) Understand Process Synchronization and Deadlocks.
4) Explore Memory Management and Virtual Memory Concepts.
5) Understand File, I/O Systems, and Security.
6) Explain disk operations, scheduling algorithms, and disk reliability methods for managing disk performance and formatting.

Prerequisite: Good knowledge of C, Computer Organization and Architecture, x86 Assembly level programming.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	4	8%
Module-II: Process Management	12	25%
Module-III: Process Synchronization and Deadlocks	12	25%
Module-IV: Memory management and Virtual Memory	10	21%
Module-V: File and I/O Systems Management	6	13%
Module-VI: Disk Management	4	8%

SYLLABUS OUTLINE:

Module I: Introduction: [4L]

Introduction to OS, operating system functions, evaluation of OS, Types of Operating Systems: Batch, Multiprogrammed OS, Time-sharing OS, Real-time OS, Distributed OS, Network OS. System Structure,

Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services.

System Calls: System Call overview, How system call works; functionalities, features, and need of System Calls

Threads: Threads overview, benefits of threads, user and kernel threads.

Module II: Process Management: [12L]

Concept of Process and Process States (Process Life Cycle), Process Control Block (PCB), process scheduling: Scheduler, Dispatcher, scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, and priority), Context switch.

Module III: Process Synchronization and Deadlocks: [12L]

Operations on processes: Process Creation, & Termination. Inter process communication (IPC): Direct and indirect communication, Message passing vs. shared memory, Independent and Co-operating Processes, Race condition & Critical Section, Process Synchronization, Synchronization Mechanisms: Hardware solutions, Software solutions: Lock variable, Turn Variable, Interested Variable, Peterson's Solution, Semaphores, Mutex. Classical Synchronization Problems: Bounded Buffer, Readers-Writers, Dining Philosophers.

Deadlock: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module IV: Memory management and Virtual Memory: [10L]

Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging. Virtual Memory background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU, Optimal), allocation of frames, thrashing.

Module V: File and I/O Systems Management: [6L]

File concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, and indexed), and free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance. I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Protection & Security Goals of protection, domain of protection, security problem, authentication, one-time password, program threats, system threats, threat monitoring, encryption.

Module VI: Disk Management: [4L]

Disk Structure, Disk performance parameters: Seek Time, Rotational Latency, Transfer Time, Access Time, Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK. Disk Reliability and Fault Management: Bad Block Detection and Handling, RAID Levels Overview (RAID 0–6). Booting and Disk Initialization: Master Boot Record (MBR), Boot Block and Boot Loader, Disk Formatting: Low-Level Formatting (Physical), Partitioning and High-Level Formatting (File System Creation). Modern Storage Technologies: SSD vs HDD, NVMe, Hybrid Drives.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Operating System Principles, Abraham Silberchatz, Peter B.Galvin, Greg Gagne,8th Edition, Wiley Student Edition
2) Operating System-Internals and Design Principles. W. Stallings, 6th Edition, Pearson.

Reference Books:

1) Modern Operating System, Andre w s Tanenbaum, 3rd Edition, PHI
2) Operating System A concept-based Approach, 2nd Edition, D.M.Dhamdhere, TMH.
3) Principle Of Operating Systems, B.LStuart, Cengage Learning, India Edition
4) Operating system, A.s.Godbole, 2nd Edition, TMH.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									1
CO2	3	3	3	1								2
CO3	3	2	3	2								2
CO4	3	3	2									3
CO5	3	2	1	2								1
CO6	3	2	1	2								2
Avg.	3	2.33	2	2								1.67

Highly Correlated: **3**
Moderately Correlated: **2**

Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand the design of an operating system and its types. I/O structures and storage structures.

CO2: To be able to apply process scheduling algorithm in various batch process scheduling scenarios.

CO3: To be able to solve process synchronization, and deadlock avoidance problems.

CO4: To be able to compare different memory and I/O management approaches and use system calls for managing processes, memory and the file system.

CO5: To be able to understand the structure and organization of the file system.

CO6: To be able to compare and use different Disk scheduling techniques.

DATABASE MANAGEMENT SYSTEM

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Database Management System	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

THEORY

Learning objectives:

1) To understand the basic concepts and the applications of database systems
2) To be master the basics of SQL and construct queries using SQL
3) To understand the relational database design principles
4) To become familiar with the basic issues of transaction processing and concurrency control
5) To become familiar with database storage structures and access techniques

Prerequisite: Basic computer knowledge and knowledge about Data Structure and Algorithm

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	4	8%
Module-II: Database Design	6	12.5%
Module-III: Representation Model	10	21%
Module-IV: Normalization	12	25%
Module-V: Indexing Structure	6	12.5%
Module-VI: Transactions and Concurrency Control	10	21%

SYLLABUS OUTLINE:

Module-I:Introduction: [4L]
Concept & Overview of DBMS, Applications, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS,

Module-II: Database Design: [6L]
Entity-relationship model, network model, relational and object oriented data models, integrity constraints,

data manipulation operations. Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas.

Module-III: Representation Model: [10L]
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database, Concept of procedural language and non-procedural language: DDL, DML, DCL, Concept of. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries.

Module-IV: Normalization: [12L]
Functional Dependency, Anomalies in a Database, The normalization process: Conversion to first normal form, Conversion to second normal form, Conversion to third normal form and BCNF, Fourth Normal form and fifth normal form, normalization and database design, Denormalization, Lossless join decomposition, Dependency preservation

Module-V: Indexing Structure: [6L]
Necessity of index structures, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Module-VI: Transactions and Concurrency Control: [10L]
Introduction of transaction processing, advantages and disadvantages of transaction processing system, online transaction processing system, serializability and recoverability, view serializability. Serializability: Enforcing, Serializability by Locks, Locking Systems With Several, Lock Modes, Architecture for a Locking Scheduler Managing Hierarchies of Database Elements, Concurrency Control by Timestamps, Concurrency Control by Validation.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.
2) Fundamentals of Database Systems, Elmasri Navathe Pearson Education.

Reference Books:

1) An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition.

2) Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1							1
CO2	3		2			1						2
CO3	2	2		2	1							1
CO4			2	1		1						
CO5	2	2			1							
CO6		2	2	1								2
Avg.	1.66	1.33	1.33	0.83	0.5	0.33						1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to discuss basic concepts, data models, types of users and appreciate the applications of database systems.

CO2: To be able to understand the logical design of the database including E-R models and the concept of generalization, specialization and aggregation.

CO3: To be able to apply with a relational database system and Normalization.

CO4: To be able to explain the basic concepts of relational database design, relational algebra and SQL.

CO5: To be able to analyze relational database and formulate SQL queries on data.

CO6: To be able to describe transaction processing and concurrency control concepts.

ARTIFICIAL INTELLIGENCE

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Artificial Intelligence	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

THEORY

Learning objectives: On completion of the course, student will be able to: Develop problem-solving ability, incorporate knowledge representation, allow continuous learning, encourage social Intelligence, achieve general intelligence, Promote synergy between humans and AI

Prerequisite: Basic computer knowledge and Data Structure and Algorithm.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to AI & Agents	6	12.5%
Module-II: Search Techniques	10	21%
Module-III: Logic	14	29%
Module-IV: Knowledge Representation	6	12.5%
Module-V: Expert Systems	6	12.5%
Module-VI: Optimization Technique	6	12.5%

SYLLABUS OUTLINE:

Module-I: Introduction to AI & Agents [6L]

Introduction to AI, Problems of AI, Application of AI, Tic- Tac- Toe problem, Types of AI, Agents & environment, nature of environment, structure of agents, Types of agents.

Module-II: Searching Techniques [10L]

Search algorithms, Uninformed Search Algorithm, Informed Search Algorithm, Hill- Climbing algorithm, Adversarial Search, Minimax Algorithm, Alpha-Beta Pruning.Problem space, state space search, problem solving agents, searching for solutions. Water jug problem, N-Queen Problem, 8 Puzzle Problem.

Module-III: Logic [14L]

Propositional Logic, Rule of inference, Types of inference rules, The Wumpus world, First order logic, inference in first order logic, computable functions and predicates, Reasoning in AI, inductive and deductive reasoning.

Classical sets vs Fuzzy Sets- Need for fuzzy sets– Definition and Mathematical representations- Level Sets– Fuzzy functions- Zadeh's Extension Principle. Operations on Fuzzy: negation, triangular norms, t-conorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations. Fuzzy Binary and n-ary relations- composition of fuzzy relations- Fuzzy Equivalence Relations- Fuzzy Compatibility Relations- Fuzzy Relational Equations. Fuzzy Decision Making- Fuzzy Relational Inference- Compositional Rule of Inference- Efficiency of Inference- Hierarchical. Fuzzy If-Then Rule Base- Inference Engine– Mamdani, SugenoDefuzzification.

Module-IV: Knowledge Representation [6L]
Knowledge representation, Types of knowledge, relation between knowledge and intelligence, AI knowledge cycle, Approaches to knowledge representation, Techniques of knowledge representation

Module-V: Expert Systems [6L]
Learning in problem solving, statistical and rule-based learning, incremental learning. Introduction to Natural language Processing and Expert Systems, syntactic processing, semantic analysis.Future of AI, Case Studies on various real-world applications of AI in different sectors.

Module-VI: Optimization Technique [6L]
Introduction of optimization technique, Genetic Algorithm, Simulated annealing, Ant Colony and Particle Swarm Optimization.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Russell, Stuart, and Peter Norvig. Artificial Intelligence: A Modern Approach. 3rd ed., Pearson, 2016.
2) Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006.
3) Goodfellow, Ian, et al. Deep Learning. MIT Press, 2016.

Reference Books:

1) Sutton, Richard S., and Andrew G. Barto. Reinforcement Learning: An Introduction. 2nd ed., MIT

Press, 2018.
2) Poole, David, and Alan Mackworth. Artificial Intelligence: Foundations of Computational Agents. Cambridge University Press, 2017.
3) Murphy, Kevin P. Machine Learning: A Probabilistic Perspective. MIT Press, 2012.
4) Heaton, Jeff. Artificial Intelligence for Humans. CreateSpace Independent Publishing Platform, 2015.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2		2	2	2								
CO3				2	2	2						2
CO4		3	2	1								1
CO5	1	2		2	1							1
CO6			2	2	2			1	1			1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand the informed and uninformed problem types and apply search strategies to solve them.

CO2: To be able to apply difficult real-life problems in a state space representation so as to solve them using AI techniques like searching and game playing.

CO3: To be able to design and evaluate intelligent expert models for perception and prediction from intelligent environment.

CO4: To be able to Identify valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.

CO5: To be able to demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.

CO6: To be able to analyse the issues involved in knowledge bases, reasoning systems and planning.

DESIGN AND ANALYSIS OF ALGORITHMS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Design and Analysis of Algorithms	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

THEORY

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

1) Understand and analyze the efficiency of algorithms using asymptotic analysis and various algorithmic strategies such as Divide and Conquer, Greedy, and Dynamic Programming.
2) Apply graph algorithms, string matching techniques, and specialized algorithms for computational problems like integer exponentiation, polynomial evaluation, and computational geometry.
3) Learn the concepts of computational complexity, including P, NP, NP-complete, and NP-hard problems, and use approximation algorithms to tackle NP-complete challenges.

Prerequisite: Discrete Maths, Programming and Data Structure, basic concept of Algorithm

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Algorithms	8	17%
Module-II: Algorithmic Strategies	10	20%
Module-III: Graph Algorithms	8	17%
Module-IV: String Matching	6	12%
Module-V: Specialized Algorithms and Applications	8	17%
Module-VI: Tractable and Intractable Problems	8	17%

SYLLABUS OUTLINE:

Module-I: Introduction to Algorithms [8L]

Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-off, asymptotic notation- big (O) notation, big (Ω) notation, (Θ) notation, small (o) notation and small (ω) notation, analysis of recursive algorithms through recurrence relations: Substitution method, Recursion

tree method, and Masters' theorem.

Module-II: Algorithmic Strategies: [12L]
Brute-Force, Divide and Conquer: binary search, merge sort and quick sort, Greedy: Fractional Knapsack problem, Job sequencing with deadlines.

Dynamic Programming: matrix chain multiplication, 0-1 Knapsack, LCS Branch-and-Bound: 15-puzzle problem and Backtracking: Eight Queens Problem.

Module-III: Graph Algorithms: [8L]
Minimum Spanning Tree (Prim's and Kruskal's algorithms), disjoint set operations, union and find algorithms. Shortest Path Algorithms: Single-source shortest path (Dijkstra's Algorithm, Bellman-Ford Algorithm), All-pairs shortest path (Floyd-Warshall Algorithm).

Module-IV: String Matching: [4L]
Introduction, The naive string matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm.

Module-V: Specialized Algorithms and Applications: [8L]
Integer exponentiation; Euclid's algorithm for GCD; DFT, FFT algorithm; Polynomial evaluation and multiplication of polynomials; Computational Geometry: line segment properties, convex hull.

Module-VI: Tractable and Intractable Problems: [8L]
Computability of Algorithms, Computability classes– P, NP, NP-complete and NP-hard. Standard NP-complete problems and Reduction techniques, Circuit Satisfiability problem, Clique Decision Problem, Approximation algorithms: TSP.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson.
2) Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill. Pearson Publication.
3) Fundamentals of Algorithms – Horowitz Ellis, SahaniSartaz, R. Sanguthevar.
4) The Design and Analysis of algorithms- A.Aho, J.Hopcroft and J.Ullman

Reference Books:

1) Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2) Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition
3) Michael T Goodrich and Roberto Tamassia, Wiley.
4) Algorithms– A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	1	1	1									
CO3	3	3	3									
CO4	2	2										
CO5	2	2		2	2							
CO6	3	3		3								
Avg.	2.33	1.83	0.66	0.83	0.33							

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Analyze algorithms using asymptotic notations and evaluate their time and space complexity, understanding algorithmic efficiency through recurrence relations and performance trade-offs.

CO2: Apply algorithmic strategies such as Brute-Force, Divide and Conquer, Greedy, and Dynamic Programming to solve complex problems, including knapsack, job sequencing, and puzzle-based problems.

CO3: Implement and analyze graph algorithms to find the shortest paths, minimum spanning trees, and solve network flow problems using algorithms like Prim's, Kruskal's.

CO4: Apply and compare different string matching algorithms, including the Naive, Rabin-Karp, and Knuth-Morris-Pratt (KMP) algorithms, to efficiently solve pattern-matching problems.

CO5: Solve mathematical and geometric problems using specialized algorithms such as integer exponentiation, Euclid's GCD, FFT, polynomial multiplication, and computational geometry techniques like convex hulls.

CO6: Classify problems based on computational complexity classes (P, NP, NP-complete, and NP-hard)

and apply reduction techniques and approximation algorithms to address intractable problems like the TSP.

SOFT-SKILL DEVELOPMENT-IV

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Soft-Skill Development-IV	**COURSE CREDIT:** 01[1-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: MVSSU122T04	**SEMESTER:** 4^{th}

THEORY

Learning objectives:

1) To master advanced reasoning techniques.
2) To improve quantitative, verbal, and analytical reasoning skills.
3) To acquire proficiency in aptitude and reasoning across various test sections.
4) To enhance presentation and public speaking abilities.

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Advance logic & reasoning		65%
Module-II: Aptitude and Reasoning		25%
Module-III: Personality Development		5%
Module-IV: Professional grooming		5%

SYLLABUS OUTLINE:

Module I: Advance logic & reasoning: [L]

- Coding–Decoding
- Number Series
- Odd One Out
- Abstract Reasoning Puzzles
- Cube, Cuboid, Unboxing
- Statements & Conclusion

Module II: Aptitude and Reasoning: [L]

- Classification of Numbers II
- Factors & Factorial II
- Profit and Loss
- Dishonest Seller
- Variation and Progression
- Pipes & Cisterns
- Permutations & Combinations (P&C)
- Probability

Module III: Personality Development: [L]

- Communication Skills and Personality Development
- Attitude Development
- Character Development
- Time Management

Activities: In prompt to speeches, mock presentations, postmaster exercises, audience interaction, stage presence

Module IV: Professional grooming: [L]

- Body Language Do's and Don'ts
- A Guide to Dressing
- Small Talk
- Building Rapport
- Expanding Social and Corporate Associations

Activities: Role play, emotional intelligence exercises, conflict resolution, peer feedback, cultural awareness

- ***Pedagogy for Course Delivery:*** Workshop, Group Discussions, Presentations, Lectures.
- ***List of Professional Skill Development Activities (PSDA):***
  - In prompt to speeches,
  - mock presentations,
  - postmaster exercises,
  - audience interaction,
  - stage presence,
  - Role play,
  - emotional intelligence exercises,
  - conflict resolution,

- peer feedback,
- cultural awareness.

- ***Continuous assessment:*** Quiz/assessment/presentation/problem solving etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	2	3
CO2	-	-	-	-	-	-	-	-	1	2	1	3
CO3	-	-	-	-	-	-	-	-	1	3	2	3
CO4	-	-	-	-	-	-	-	-	1	2	2	3
CO5	-	-	-	-	-	-	-	-	1	2	2	3
CO6	-	-	-	-	-	-	-	-	1	2	1	3
Avg.	-	-	-	-	-	-	-	-	1	2.33	1.67	3

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To improve quantitative reasoning skills for effective problem-solving in mathematical contexts.

CO2: To enhance verbal and analytical reasoning skills for comprehensive understanding and logical analysis.

CO3: To acquire proficiency in aptitude and reasoning across various test sections to excel in competitive exams.

CO4: To enhance presentation and public speaking abilities for clear and confident communication.

CO5: To cultivate a professional demeanor and appearance, essential for career advancement and work-place success.

CO6: To develop skills and strategies to enhance career readiness and professional growth.

ADVANCED PROGRAMMING TECHNIQUES WITH R AND PYTHON

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Advanced Programming Techniques with R and Python	**COURSE CREDIT:** 03[1-0-4]
DEPARTMENT: Computer Science	**CATEGORY:** SEC
CODE: XXXXXX	**SEMESTER:** 4^{th}

THEORY

Learning objectives: The course covers data reading and its manipulation using R, which is widely used for data analysis internationally. The course also covers different control structures and design of user-defined functions. Loading, installing and building packages are covered.To provide exposure to basic problem-solving techniques with computers. To develop the logical thinking abilities and to propose novel solutions for real world problems through programming language constructs.

Prerequisite: Fundamentals of Programming.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Python Programming	6	16%
Module-II: Control Structures and collection	6	17%
Module-III: Strings and Regular Expressions and File Handling	6	17%
Module-IV: Introduction to R: Describing Data, Visualizing Data	6	16%
Module-V: Probability Distributions and Densities of Random Variables, Tests of Hypotheses	6	17%
Module-VI: Linear Relationship	6	17%

SYLLABUS OUTLINE:

Module I: Introduction to Python Programming: [6L]

Introduction to Python, Demo of Interactive and script mode, Tokens in Python – Variables, Keywords, Comments, Literals, Data types, Indentation, Operators and its precedence, Expressions, Input and Print

functions. Sequential approach.

Module II: Control Structures and collection: [6L]

Selective statements – if, if-else, nested if, if –elif ladder statements Iterative statements - while, for, Nested loops, else in loops, break, continue and pass statements.List: Create, Access, Slicing, Negative Indices, List Methods, and comprehensions Tuples: Create, Indexing and Slicing, Operations on tuples. Dictionary: Create, add, and replace values, operations on dictionaries. Sets: Create and operations on set.

Module III: Strings and Regular Expressions and File Handling: [6L]

Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions. Regular expression: Matching the patterns, Search and replace. Files: Open, Read, Write, Append and Close. Tell and seek methods.

Module IV: Introduction to R: Describing Data, Visualizing Data: [6L]

R interpreter, Introduction to major R data structures like vectors, matrices, arrays, list and data frames, Control Structures, vectorized if and multiple selection, functions. Viewing and Manipulating Data, Plotting Data, Reading Data. Tables, charts and plots, Visualising Measures of Central Tendency, Variation and Shape. Box plots, Pareto diagrams, How to find the mean median standard deviation and quantiles of a set of observations., Students may experiment with real as well as artificial data sets.

Module V: Probability Distributions and Densities of Random Variables, Tests of Hypotheses: [6L]

Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions, Densities of Random Variables: Off the Shelf Distributions in R , Matching a Density to Data , More About Making Histograms. How to perform tests of hypotheses about the mean when the variance is known, How to compute the p-value, Explore the connection between the critical region, the test statistic, and the p-value.

Module VI: Linear Relationship: [6L]

A Statistical Model for a Linear Relationship: Least Squares Estimates, The R Function lm , Scrutinizing the Residuals

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Maria Dolores Ugarte , Ana F. Militino , Alan T. Arnholt “Probability and Statistics with R” 2nd Edition on, CRC Press, 2016.

Reference Books:

1) P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	3	3	1								1
CO3	3	3	3	2								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5								0.83

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Develop an R script and execute it

CO2: Install, load and deploy the required packages, and build new packages for sharing and reusability

CO3: Extract data from different sources using API and use it for data analysis

CO4: Visualize and summarize the data

CO5: Design application with database connectivity for data analysis

CO6: Implement different machine learning classifiers

OPERATING SYSTEMS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Operating Systems Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

List of Practical:

1) **Section 1:**
   a) Write a shell script to take the name of the user as input and print it.
   b) Write a shell script to multiply two numbers and display the output.
   c) Write a shell script program to emulate the calculator function.
   d) Write a shell script that will find the maximum from the given three no.
   e) Write a shell script that will find the GCD of two given numbers.
   f) Write a shell script to generate a Fibonacci series of length with the first two no. of the series is 3 and 5 respectively.
   g) Write a Shell script to take 'n' number of elements in an array and print the third largest number. Value of 'n' must be taken from the terminal.
   h) Store 'n' number of elements in an array and find out the sum of the array elements. Value of 'n' must be taken from the terminal.
   i) Write a shell program that will accept 10 numbers from the
   j) terminals and will search the position of a given no in the supplied nos.
   k) Write a program in C under Linux to create a file.
   l) Write a shell script program to search an integer in an array using linear search.
2) **Section 2:**
   a) Write a C Program that will create a child process. Then print the process id & parent process id both from the child as well as from the parent.
   b) Write a C program that will create a child process. Then modify the value of a globally defined variable from the child process and print the value of the variable from the parent process.
   c) Write a c program that will take the name of person as command line argument and then it will print hallo name. Then write another program that will create a process using fork(). Then execute the previously created c program (hallo program) by the child process.
   d) Write a program in C under Linux to copy the content of one file to another from command line.
   e) Write a program in C to implement LRU page replacement algorithm
   f) Write a program in C to implement CPU scheduling using Round Robin Scheduling algorithm

g) Write a program in C to implement CPU scheduling using FCFS Scheduling algorithm
h) Write a program in C to implement CPU scheduling using SJF Scheduling algorithm.

3) **Section 3:**

a) Write a C program for implementing the Producer Consumer problem using Thread Synchronization.
b) Write a C program to count a number from 1 to 20 using two threads (Thread 1 and Thread where the prime numbers are printed by Thread 1 and non prime numbers are printed by Thread 2.

4) **Section 4:**

a) Write a program in C that demonstrates how two processes can share a variable using semaphore.
b) Write a C program to implement Semaphore to print from a parent as well as a child process, where both parent and child will print two consecutive words from a sentence.
c) Write a program in C to solve the Producer Consumer problem using POSIX semaphore.

5) **Section 5:**

a) i) Display the absolute path of your home directory.
ii) Create a new subdirectory called 'Sister Nivedita University' in your home directory.
iii) Create a new subdirectory called 'Student' in Sister Nivedita University.
iv) Create a new subdirectory called 'Teacher' in Sister Nivedita University.
v) Display the contents of the directory 'Sister Nivedita University'.
vi) Delete the directory 'Teacher'.
vii) Display the contents of the directory 'Sister Nivedita University' in detail .
viii) Write Unix Commands to do the following directory manipulation.
b) Write a program to create a pipe between parent and child and to send data down the pipe.
c) Write a program to convert lower case to upper case using FIFO pipe where the client sends a string in lower case to the server and the server responds with the string in Upper case back to the client.
d) Write a program to implement IPC using shared memory between two processes.
e) Write a program to implement IPC using message queue between two processes.
f) Write a C program to calculate the seek time by applying FCFS, SSTF, SCAN,C-SCAN algorithms

DATABASE MANAGEMENT SYSTEM LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Database Management System Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

List of Practical:

1) **Introduction to SQL:**
   a) Basic concepts of databases and DBMS
   b) Introduction to Structured Query Language (SQL)
   c) Creating, querying, updating, and deleting tables using SQL
2) **Data Definition Language (DDL):**
   a) Creating and modifying database schema using DDL commands (CREATE, ALTER, DROP)
   b) Constraints (PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, CHECK)
3) **Data Manipulation Language (DML):**
   a) Inserting, updating, and deleting data using DML commands (INSERT, UPDATE, DELETE)
   b) Retrieving data using SELECT statement
   c) Filtering data using WHERE clause
   d) Sorting data using ORDER BY clause
   e) Aggregating data using GROUP BY and aggregate functions (SUM, AVG, COUNT, MAX, MIN)
4) **Joins and Subqueries:**
   a) Performing joins (INNER JOIN, LEFT JOIN, RIGHT JOIN, FULL JOIN)
   b) Writing subqueries to retrieve data
   c) Understanding correlated subqueries
5) **Indexes and Views:**
   a) Creating indexes for efficient data retrieval
   b) Creating and managing views
   c) Understanding materialized views
6) **Transactions and Concurrency Control:**
   a) Introduction to transactions
   b) ACID properties of transactions
   c) Isolation levels (READ UNCOMMITTED, READ COMMITTED, REPEATABLE READ, SERIALIZABLE)

d) Locking mechanisms for concurrency control

7) **Database Connectivity:**
   a) Connecting to databases using programming languages (e.g., Java, Python) and APIs (e.g., JDBC, SQLAlchemy)
   b) Performing CRUD operations through programming languages
8) **Database Administration:**
   a) Managing users and permissions
   b) Backup and recovery strategies
   c) Monitoring database performance
   d) Tuning SQL queries for better performance
9) **Normalization:**
   a) Understanding normalization forms (1NF, 2NF, 3NF, BCNF)
   b) Applying normalization techniques to improve database design
10) Stored Procedures and Triggers:
   a) Creating and executing stored procedures
   b) Defining and executing triggers

Database Design Project:

Students may be assigned a database design project where they have to design a database schema, implement it using SQL, and develop a simple application to interact with the database.

ARTIFICIAL INTELLIGENCE LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Artificial Intelligence Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 4^{th}

List of Practical:

1) Execute the Basic Operations of SWI Prolog and Python along with the installation process of Python Jupyter Notebook and SWI Prolog
2) Implementation of relational tree structure in SWI Prolog
3) Implementation of Circuit Design Logic Using SWI Prolog
4) Implementation of Predecessors and Successors in SWI Prolog
5) Implementation of Graph Colouring(Vertices, Edges, Regions) in SWI Prolog
6) Implementation of Greedy Algorithm using Python
7) Hill Climbing and A* Algorithm using Python
8) Implement BFS and DFS using Python
9) Implement the Tower of Hanoi using SWI Prolog and Python
10) Implement BFS and DFS using Python
11) 4 Queens Problem using Python
12) Basic implementations and innovative algorithm design using of 2 Fuzzy Sets like Union, Intersection, Negation etc. using Python
13) Case Study with Analysis

THIRD YEAR

SEMESTER-V

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Computer Networks		MC	4	3	1	0	0
2	Software Engineering and Agile Methodology		MC	4	3	1	0	0
3	Machine Learning/ Advanced Algorithms		ME	3	2	1	0	0
4	NM Elective-II: Digital Signal Processing/ VLSI Design		NM	4	3	1	0	0
5	Soft-Skill Development-V		NV	1	1	0	0	0
6	SEC2: Programming with Advanced Java		SEC	3	1	0	4	0
7	MDC III: Design Thinking/ Industrial Psychology		MDC	3	2	1	0	0
Practical								
8	Computer Networks Lab		MC	1	0	0	2	0
9	Software Engineering and Agile Methodology Lab		MC	1	0	0	2	0
10	Machine Learning Lab/ Advanced Algorithms Lab		ME	1	0	0	2	0
Total Credit=25								

COMPUTER NETWORKS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Computer Networks	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

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

1) Describe the general principles of data communication.
2) Describe how computer networks are organized with the concept of layered approach.
3) Describe how signals are used to transfer data between nodes.
4) Implement a simple LAN with hubs, bridges and switches.
5) Describe how packets in the Internet are delivered.
6) Analyze the contents in a given data link layer packet, based on the layer concept.
7) Design logical sub-address blocks with a given address block.
8) Decide routing entries given a simple example of network topology
9) Describe what classless addressing scheme is.
10) Describe how routing protocols work.
11) Use C programming language to implement network programs.
12) Design and implement a network protocol.

Prerequisite: Analog and Data Communication, Algorithm, and Programming logic.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Data Communication	4	8%
Module-II: Physical layer and Media	10	21%
Module-III: Data Link Layer and Medium Access Sub Layer	12	25%
Module-IV: Network Layer	10	21%
Module-V: Transport Layer	6	13%
Module-VI: Application Layer	6	13%

SYLLABUS OUTLINE:

Module I: Introduction to Data Communication: [4L]

Components, Representation of data and its flow networks, Physical structures, Connection Topology, Protocols and Standards, OSI model, TCP/IP Protocol suite, Addressing.

Module II: Physical layer and Media: [10L]

Analog and Digital data, Signals, Transmission impairment, Data rate limit and Performance, Digital to Digital conversion, Analog to Digital conversion, Digital to Analog conversion, Analog to Analog conversion, Multiplexing and Spectrum Spreading: Multiplexing, Spread Spectrum, Transmission media: Guided Media, Unguided Media, Switching: Introduction, circuit switched networks, packet switched network, switching, structure of a switch.

Module III: Data Link Layer and Medium Access Sub Layer: [12L]

Error Detection and Error Correction- Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA. HDLC, Ethernet, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN.

Module IV: Network Layer: [10L]

Logical addressing– IPV4, IPV6; Address mapping– and DHCP–Delivery, Forwarding Unicast Routing protocols: RIP, OSPF, BGP Multicast Routing Protocol:

Module V: Transport Layer: [6L]

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP)s; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module VI: Application Layer: [6L]

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Computer Networks, Andrew. S. Tanenbaum, 4/e, Prentice Hall of India Private Ltd, 2003.
2) Data Communications and Networking, Behrouz A Forouzan, 4/e, Tata McGraw Hill Education Private Limited.

Reference Books:

1) Data Communications & Networks, Achyut S. Godbole, Tata McGraw Hill Education Private Limited.
2) Data and Computer Communication, William Stalling, 7/e, Prentice Hall of India Private Ltd.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2								1
CO2	3	3	2	3								1
CO3	3	3	2	2	2							
CO4	2	3	3	3	2	2						
CO5	3	2	1	2	2	2						
CO6	2	2	1	1	2							1
Avg.	2.5	2.5	1.67	2.17	1.33	0.67						0.5

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand data communication components, representation of data, physical topologies, and protocols.

CO2: To be able to understand Analog and Digital transmission, multiplexing and transmission media.

CO3: To be able to solve problems related to error correction/detection and protocols of media access control layer.

CO4: To be able to solve IP subnetting problems and routing problems.

CO5: To analyze basic operations of transport layer and congestion control mechanisms.

CO6: To be able to understand about various application layer functionalities.

SOFTWARE ENGINEERING AND AGILE METHODOLOGY

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Software Engineering and Agile Methodology	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives: Students will be able to introduce the fundamental concepts of Software development process, to teach the concepts of system analysis and design for system requirement specification,to introduce the principles of Coding, Testing, documentation, and project Management.

Prerequisite: Basic computer knowledge and Data Structure and Algorithm.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	8	17%
Module-II: Software Project Management and Agile Methodologies	10	21%
Module-III: Software Quality and Reliability	10	21%
Module-IV: Software Requirements Analysis, Design and Construction	10	21%
Module-V: Object Oriented Analysis, Design and Construction	4	8%
Module-VI: Software Testing	6	12%

SYLLABUS OUTLINE:

Module I: Introduction: [8L]

Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline, Software Engineering Historical Development from Jackson Structured Programming to Agile Development.

Module II: Software Project Management and Agile Methodologies: [10L]

Basic concepts of life cycle models – different models and milestones; software project planning – identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

Module III: Software Quality and Reliability: [10L]

Software quality; Garvin's quality dimensions, McCall's quality factor, ISO 9126 quality factor; Software Quality Dilemma; Introduction to Capability Maturity Models (CMM and CMMI); Introduction to software reliability, reliability models and estimation.

Module IV: Software Requirements Analysis, Design and Construction: [10L]

Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modelling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics-based control methods; measures of code and design quality

Module V: Object Oriented Analysis, Design and Construction: [4L]

Concepts -the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object-oriented construction principles; object-oriented metrics.

Module VI: Software Testing: [6L]

Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection; Unit Testing, Integration Testing, System Testing and Acceptance Testing.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Sommerville, Ian. Software Engineering. 10th ed., Addison-Wesley, 2015.
2) Pressman, Roger S. Software Engineering: A Practitioner's Approach. 9th ed., McGraw-Hill Education, 2021.
3) Pfleeger, Shari Lawrence, Joanne M. Atlee, and Robert L. Glass. Software Engineering: Theory and Practice. 4th ed., Pearson, 2014.
4) Ian, Mauro Pezzè, and Michal Young. Software Testing and Analysis: Process, Principles, and Techniques. Wiley, 2007.

Reference Books:

1) Ghezzi, Carlo, Mehdi Jazayeri, and Dino Mandrioli. Fundamentals of Software Engineering. 2nd ed., Prentice Hall, 2010.
2) Bass, Len, Paul Clements, and Rick Kazman. Software Architecture in Practice. 3rd ed., Addison-Wesley, 2012.
3) Shaw, Mary, and David Garlan. Software Architecture: Perspectives on an Emerging Discipline. Prentice Hall, 1996.
4) Wazlawick, Raul Sidnei. Object-Oriented Analysis and Design for Information Systems: Modeling with UML, OCL, and IFML. Elsevier, 2014.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2		1						1		
CO2	2	2	3									
CO3	3	2	3			2						
CO4		2							1	1		
CO5	1	2		1					2			1
CO6		1	3		3					1		1
Avg.	1	1.83	1.5	0.33	0.5	0.33			0.5	0.5		0.33

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Ability to apply software engineering principles and techniques and understand the SDLC, SRS.

CO2: Ability to develop, maintain and evaluate software design.

CO3: Analyze the coding standard and justify the code with different testing techniques.

CO4: Apply the knowledge of system design for testing software in various environment.

CO5: Estimate the scheduling and budgeting for maintaining the project management, and illustrate the quality control and maintenance of software.

CO6: To be able to analyze the interaction among various model in a software design using Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, and implementation diagram.

MACHINE LEARNING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Machine Learning	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives:

- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Prerequisite: Knowledge of Artificial Intelligence, Linear algebra, Calculus, Mathematical logic and differential equation.

Course content/Syllabus table:

Module No.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction to Machine Learning	3	8%
Module-II: Feature Engineering	4	11%
Module-III: Supervised Learning	12	33%
Module-IV: Model Evaluation and Tuning	4	11%
Module-V: Unsupervised Learning	7	20%
Module-VI: Neural Networks and Deep Learning	6	17%

SYLLABUS OUTLINE:

Module I: Introduction to Machine Learning: [3L]

Basic Concepts of Machine Learning, Types of Machine Learning, Supervised Learning Versus Unsupervised Learning Versus Reinforcement Learning, Regression Versus Classification Versus Clustering problems, Generative and Discriminative Algorithms.

Module II: Feature Engineering: [4L]

Introduction to Data Processing, ETL, Measurement of Purity, Entropy, Information Gain and Gini Index, Normalization and Standardization.

Module III: Supervised Learning: [12L]

Introduction to Supervised Learning, Concepts of Linear Algebra, Linear Regression, Logistic Regression, Loss function, Learning algorithm: Gradient Descent, Generative Learning Algorithms, Naive Bayes, K-nearest neighbor (KNN) algorithm, Decision tree, Random Forest, Bagging and Boosting, Concepts of Bias/ Variance Trade-off, Maximum Entropy, Gaussian Discriminant Analysis, Linear Discriminant Analysis (LDA), Concepts of Vectorization, Support Vector Machines, Ensemble methods.

Module IV: Model Evaluation and Tuning: [4L]

Underfitting and Overfitting Problem, Regularization, Bias-Variance as Function of Lambda, Cross Validation, Learning Curves, Error Analysis, Confusion Matrix, Performance evaluation metrices: Accuracy, Precision, Recall, F1-Score, etc. Receiver Operating Characteristic (ROC) Curve, Area Under the Curve (AUC), Cumulative Match Characteristic (CMC) curve.

Module V: Unsupervised Learning: [7L]

Introduction to Unsupervised Learning, K-means Clustering and Hierarchical Clustering, Comparison among Classification and Clustering, Dimensionality Reduction: Principal Component Analysis (PCA), Factor Analysis, Measuring Cluster Similarities: Rand Index (RI).

Module VI: Neural Networks and Deep Learning: [6L]

McCulloch-Pitts (MP) Neuron, Perceptron, Basic Concept of Neural Network, Learning Algorithm: Gradient Descent with Back Propagation, Introduction to Deep Learning and its Applications.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006.
2) Alpaydin, Ethem. Introduction to Machine Learning. 3rd ed., The MIT Press, 2014.
3) Murphy, Kevin P. Machine Learning: A Probabilistic Perspective. The MIT Press, 2012.
4) Marsland, Stephen. Machine Learning: An Algorithmic Perspective. 2nd ed., CRC Press, 2014.

Reference Books:

1) Shalev-Shwartz, Shai, and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014.
2) Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. 2nd ed., O'Reilly Media, 2019.
3) Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. 2nd ed., Springer, 2009.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	1
CO2	3	2	-	2	1	-	-	-	-	-	-	2
CO3	2	2	3	2	2	-	-	-	-	-	-	2
CO4	1	2	3	3	2	-	-	-	-	-	-	3
CO5	2	2	3	3	3	-	-	-	-	-	-	3
CO6	-	2	3	3	2	-	-	-	-	-	-	2
Avg.	2.20	2.17	2.80	2.33	2.00							2.20

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to discuss the basics of learning problems with hypothesis.

CO2: To be able to understand the features of machine learning to deal with real world problems.

CO3: To be able to differentiate the machine learning algorithms as supervised learning and unsupervised learning.

CO4: To be able to design and analyze various classification and clustering algorithms.

CO5: To be able to develop and tune the machine learning models with datasets.

CO6: To be able to evaluate the models for optimization engineering problems.

ADVANCED ALGORITHMS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Advanced Algorithms	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives: To design the algorithms for solving different types of problems in Computer Science. It also helps to design and analyse the logic on how the program will work before developing the actual code for a program.

Prerequisite: The students should have basic knowledge in Discrete Mathematics, Programming and Data Structure.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Design Paradigms: Overview	4	11%
Module-II: Graph	8	23%
Module-III: Theory of NP- Hard and NP-Complete Problems	4	11%
Module-IV: Approximation Algorithms	8	22%
Module-V: Parallel Algorithms	8	22%
Module-VI: Probabilistic Algorithms & Randomized Algorithms	4	11%

SYLLABUS OUTLINE:

Module I: Design Paradigms: Overview: [4L]

Overview of Divide and Conquer, Greedy and Dynamic Programming strategies. Basic search and traversal techniques for graphs, Backtracking, Branch and Bound.

Module II: Graph: [8L]

Network Flow Algorithms: Maximum flow problem, Ford-Fulkerson Algorithm and its variants (Edmonds-

Karp implementation), Maximum Bipartite Matching, Applications of max-flow: Image segmentation, airline scheduling, etc.; Minimum Cut Theorem and Max-Flow Min-Cut Theorem.

Graph connectivity, Biconnectivity and articulation points in graphs; Planarity testing.

Module III: Theory of NP- Hard and NP-Complete Problems: [4L]
P, NP and NP-Complete complexity classes; A few NP-Completeness proofs; Other complexity classes.

Module IV: Approximation Algorithms: [8L]
Introduction, Combinatorial Optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, TSP, knapsack, bin packing, subset-sum problem etc. Analysis of the expected time complexity of the algorithms.

Module V: Parallel Algorithms: [8L]
Introduction, Models, speedup and efficiency, Some basic techniques of Parallel algorithms: Computing with a CBT, Pointer Doubling, Examples from graph theory, sorting, Parallel sorting networks. Parallel algorithms and their parallel time and processors complexity.

Module VI: Probabilistic Algorithms & Randomized Algorithms: [4L]
Numerical probabilistic algorithms, Huffman coding, Las Vegas and Monte Carlo algorithms, Game-theoretic techniques, Applications on graph problems.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Introduction to Algorithms, T. H. Cormen, C. E. Leiserson and R. L. Rivest.
2) The Design and Analysis of Computer Algorithms, A. Aho, J. Hopcroft and J. Ullman.

Reference Books:

1) Fundamental of Computer Algorithms, E. Horowitz and S. Sahni.
2) The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, .D. E. Knuth.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							
CO2	3	3	3	1	1							1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5	0.3							0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Apply algorithm design strategies like Divide and Conquer, Greedy, and Dynamic Programming to solve complex computational problems.

CO2: Solve the Max-Flow problem using the Ford-Fulkerson and Edmonds-Karp algorithms in flow networks.

CO3: Classify computational problems into P, NP, and NP-Complete classes and analyze their complexity.

CO4: Design and analyze approximation algorithms for combinatorial optimization problems, including Vertex Cover, TSP, and Knapsack.

CO5: Evaluate the performance of parallel algorithms by analyzing speedup, efficiency, and parallel time complexity.

CO6: Apply probabilistic and randomized algorithms, such as Las Vegas and Monte Carlo, to solve computational problems with uncertain inputs.

DIGITAL SIGNAL PROCESSING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Digital Signal Processing	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives: At the end of completing this course, students will learn

1) Structures of Discrete time signals and systems
2) Fast Fourier Transform Implementations, Frequency response and design of FIR and IIR filters.
3) Finite word length effects in digital filters

Prerequisite: The students will have a physics and mathematics background obtained at a high school (or equivalent) level. In particular, working knowledge of basic mathematics including differentiation and integration techniques is assumed.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Digital Signal Processing	10	21%
Module-II: Z-Transform	10	21%
Module-III: Discrete Fourier Transform (DFT)	10	21%
Module-IV:Design of FIR Digital filters	10	21%
Module-V: Application of DSP	8	16%

SYLLABUS OUTLINE:

Module I: Digital Signal Processing: [10L]

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes.

Module II: Z-Transform: [10L]

Z-Transform, Analysis of LSI systems, frequency Analysis, Inverse Systems

Module III: Discrete Fourier Transform (DFT): [10L]

Discrete Fourier Transform (DFT), Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Module IV: Design of FIR Digital filters: [10L]

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters.

Module V: Application of DSP: [8L]

Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multirate signal processing. Application of DSP.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2) A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.

Reference Books:

1) Oppenheim & Schafer, Digital Signal Processing. Pearson Education 2015

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							
CO2	3	3	3	1	1							1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5	0.3							0.8

Highly Correlated: **3**
Moderately Correlated: **2**

Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Design and describe different types of realizations of digital systems (IIR and FIR) and their utilities.

CO2: Select design parameters of analog IIR digital filters (Butterworth and Chebyshev filters)

CO3: Implement various methods such as impulse invariant transformation and bilinear transformation of conversion of analog to digital filters.

CO4: Design FIR filter using various types of window functions.

CO5: Define the principle of discrete Fourier transform & its various properties and concept of circular and linear convolution. Also, students will be able to define and implement FFT i.e. a fast computation method of DFT.

CO6: Define the concept of decimation and interpolation. Also, they will be able to implement it in various practical applications.

VLSI DESIGN

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: VLSI Design	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives: At the end of completing this course, students will learn

1) To introduce the students to the design principles of Digital VLSI Circuits.
2) To enable the students to solve theoretical and practical problems related to Digital VLSI Circuits.
3) To enable the students to efficiently analyze and design circuits for Digital VLSI Domain.

Prerequisite: The students will have a physics and mathematics background.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to VLSI	8	16.66%
Module-II: Introduction to MOS and CMOS technology	8	16.66%
Module-III: CMOS Device Characteristics	8	16.67%
Module-IV: CMOS Circuits	8	16.67%
Module-V: Sequential Circuits	8	16.67%
Module-VI: VLSI Design Methodology & Design tools	8	16.67%

SYLLABUS OUTLINE:

Module I: Introduction to VLSI: [8L]

Introduction to VLSI Design, Levels of abstraction and the complexity of design, Challenges of VLSI design: power, timing, area, noise, testability, reliability and yield; CAD tools: simulation, layout, synthesis and test.

Module II: Introduction to MOS and CMOS technology: [8L]

Threshold voltage equation and energy band diagram of MOSFET, controlling of threshold voltage, MOSFET current – Voltage Characteristics. Transconductance, Drain conduction. Aspect ratio, process

parameters, second order effects, MOS small signal and Large signal model, MOS capacitances. Stick diagram rules for nMOS and CMOS technology, lambda based and micron based design rules. Layout design for CMOS inverter

Module III: CMOS Device Characteristics: [8L]

Analysis of different types of inverter circuit, CMOS inverter, transfer characteristic, calculation of propagation delay, rise time, fall time, noise margin and power dissipation for CMOS Inverter. Effect of threshold voltage and supply voltage on Delay and power dissipation. Limitations of CMOS in NANO scale circuit design.

Module IV: CMOS Circuits: [8L]

CMOS logic, Complex Logic Circuits, pseudo NMOS logic, pass transistor logic, Transmission Gate logic and Dynamic logic circuit design. Designing of Combinational logic circuit using CMOS and analysis of various design parameters.

Module V: Sequential Circuits: [8L]

Sequential MOS Logic circuits, SR Latched circuits, clocked latch and Flip Flop Circuits, CMOS D latch and Edge Triggered Flip Flop, Design of the Schmitt trigger circuit, Dynamic random access and Static random access memory cell design and analysis, Sense amplifier and row and column decoder circuit.

Module VI: VLSI Design Methodology & Design tools: [8L]

Introduction to ASICs –Types, Standard Cell Array, Gate Arrays, Programmable Array Logic- PLAs, CPLDs, FPGAs.

Design Approach- Design capture tools, Design Verification Tools, Synthesis, testing.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) S.M Kang and Y.Leblebici., CMOS Digital Integrated Circuits.
2) N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design : A Systems Perspective,
3) Second Edition (Expanded), AW/Pearson, 2001.
4) J. P. Uyemura, Introduction to VLSI Circuits and System, Wiley, 2002.

Reference Books:

1) J. M. Rabaey , Digital Integrated Circuit CO-PO Mappin
2) W. Wolf, Modern VLSI Design : System on Chip, Third Edition, PH/Pearson, 2002.
3) J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, Digital Integrated Circuits : A Design Perspective,
4) Second Edition, PH/Pearson, 2003.
5) D. A. Pucknell and K. Eshraghian, Basic VLSI Design : Systems and Circuits, Third Edition, PHI, 1994.
6) J. P. Uyemura, CMOS Logic Circuit Design, Kluwer, 1999.
7) R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design, Layout and Simulation, PH, 1997.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2							
CO2	3	3	3	2	2							
CO3	3	2	2	2	2							
CO4	3	2	2	2	1							
CO5	3	1	2									
CO6	3	2	3	1	3							
Avg.	3	2.16	2.5	1.67	1.67							

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Implement the combinatorial logic circuits using MOS and CMOS technology.

CO2: Design sequential logic circuits using CMOS Technology.

CO3: Analyse various VLSI circuit configurations and their applications

CO4: Analyse the merits of VLSI circuits according to the technology and applications change.

CO5: Understand ASIC and various design approach.

CO6: Apply various CAD tools for VLSI design.

SOFT-SKILL DEVELOPMENT-V

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Soft-Skill Development-V	**COURSE CREDIT:** 01[1-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: MVSSU122T05	**SEMESTER:** 5^{th}

THEORY

Learning objectives: To prepare students for various aptitude, logic, and reasoning tests. To familiarize students with the format and types of questions in these tests. To prepare students for group discussions and provide them with an environment to practice.

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Mock Tests	12	50%
Module-II: Business Presentation Skills	5	20%
Module-III: Group Discussion	5	20%
Module-IV: Corporate & Social Etiquette	2	10%

SYLLABUS OUTLINE:

Module I: Mock Tests: [12L]

- Aptitude
- Logic and Reasoning

Module II: Business Presentation Skills: [5L]

- Discussing the significance of audio-visual aids, audience, and feedback in presentation skills
- Analyzing the significance of non-verbal communication
- Preparing effective PowerPoint presentations
- Delivering the presentation
- Handling questions

Activities: Time-limited presentations, visual aid designs, impromptu speaking, peer presentations

Module III: Group Discussion: [5L]

- PESTA format
- Do's and Don'ts of group discussions
- Initialization and conclusion
- Tips to stand out

Module IV: Corporate & Social Etiquette: [2L]

- Etiquette
- Netiquettes
- Professional mannerism

- ***Pedagogy for Course Delivery:*** Workshop, Group discussions, Presentations, Lectures
- ***List of Professional Skill Development Activities (PSDA):*** Time-limited presentations, visual aid designs, impromptu speaking, peer presentations
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	2	3
CO2	-	-	-	-	-	-	-	-	1	3	2	3
CO3	-	-	-	-	-	-	-	-	1	3	2	3
CO4	-	-	-	-	-	-	-	-	2	3	1	3
CO5	-	-	-	-	-	-	-	-	1	3	2	3
CO6	-	-	-	-	-	-	-	-	1	3	2	3
Avg.	-	-	-	-	-	-	-	-	1	3	1.83	3

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To equip students with skills to excel in various aptitude, logic, and reasoning tests

CO2: To familiarize students with test formats and question types for improved performance

CO3: To prepare students for group discussions and provide practice opportunities in a supportive environment

CO4: To develop skills for creating and delivering effective business presentations

CO5: To enhance logical and analytical reasoning abilities for comprehensive problem-solving

CO6: To build confidence in test-taking and public speaking to achieve professional and academic success

PROGRAMMING WITH ADVANCED JAVA

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Programming with Advanced Java	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** SEC
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives: This course develops programming ability of students to create dynamic web applications using server-side technology with Java Database Connectivity. Students can learn networking and remote method invocation using Java API. Different Java frameworks like Spring, Java Server Faces and Hibernate will increase ability of students in web application development.

Prerequisite: The students should have basic programming knowledge.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Advance Networking	6	16%
Module-II: JDBC Programming	6	17%
Module-III: J2EE and Web Development	6	17%
Module-IV: Servlet API and Overview	6	17%
Module-V: Java Server Pages	6	17%
Module-VI: Java Web Frameworks: Spring MVC	6	16%

SYLLABUS OUTLINE:

Module I: Advance Networking: [6L]

Networking Basics, Introduction of Socket, Types of Socket, Socket API, TCP-IP: Client/Server Sockets, URL,UDP: Datagrams, java.net package classes: Socket, ServerSocket, InetAddress, URL, URLConnection, RMI Architecture, Client Server Application using RMI

Module II: JDBC Programming: [6L]

JDBC Architecture, Types of JDBC Drivers, Introduction to major JDBC Classes and Interface, Creating simple JDBC Application, Types of Statement (Statement Interface, PreparedStatement, CallableStatement), Exploring ResultSet Operations, Batch Updates in JDBC, Creating CRUD Application, Using

Rowsets Objects, Managing Database Transaction.

Module III: J2EE and Web Development: [6L]

J2EE Architecture Types, J2EE Containers, Types of Servers in J2EE Application, HTTP Protocols and API, Request Processing in Web Application, Web Application Structure, Web Containers and Web Architecture Models.

Module IV: Servlet API and Overview: [6L]

Servlet Introduction, Servlet Life Cycle(SLC), Types of Servlet, Servlet Configuration with Deployment Descriptor, Working with ServletContext and ServletConfig Object, Attributes in Servelt,, Response and Redirection using Request Dispacher and using sendRedirect Method, Filter API, Manipulating Responses using Filter API, Session Tracking: using Cookies, HTTPSession, Hidden Form Fields and URL Rewriting,Types of Servlet Event: ContextLevel and SessionLevel.

Module V: Java Server Pages: [6L]

Introduction to JSP , Comparison with Servlet, JSP Architecture, JSP: Life Cycle, Scripting Elements, Directives, Action Tags, Implicit Objects, Expression Language(EL), JSP Standard Tag Libraries(JSTL), Custom Tag, Session Management, Exception Handling, CRUD Application.

Module VI: Java Web Frameworks: Spring MVC: [6L]

Spring: Introduction, Architecture, Spring MVC Module, Life Cycle of Bean Factory, Explore: Constructor Injection, Dependency Injection, Inner Beans, Aliases in Bean, Bean Scopes, Spring Annotations, Spring AOP Module, Spring DAO, Database Transaction Management, CRUD Operation using DAO and Spring API.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Herbert Schildt, The Complete Reference -Java, Tata McGraw-Hill Education, Tenth Edition, 2017.
2) Paul J. Deitel, Harvey Deitel ,Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014

Reference Books:

1) Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							
CO2	3	3	3	1	1							1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5	0.3							0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Interpret the basic representation of the data structures and sequential programming

CO2: Describe the components of J2EE Architecture, MVC Framework and Multi-tier Application and Various Network Protocol. (Understand)

CO3: To make use of Servlet and JSP API in the process of enterprise application deployment. (Apply) CO3: Implement components such as Session, Filters, JSTL, Beans. (Apply)

CO4: Distinguish Application Server, Web Container, JDBC and ORM tools. (Analyse)

CO5: Design and Development of web application having collaboration of Servlets, JSPs, JSF, Spring and Hibernate based upon the requirement. (Create)

CO6: Design and implement Java Applications for real world problems involving Database Connectivity(Create).

DESIGN THINKING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Design Thinking	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MDC
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives:

1) Recognize the importance of design thinking and its various phases
2) Apply design thinking phases to create successful prototypes
3) Understand that both agile and design thinking process complement each other

Prerequisite:

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Design Thinking	6	8%
Module-II: Empathize and Define Phase	4	20%
Module-III: Ideate	8	25%
Module-IV: Prototype	8	21%
Module-V: Role	6	13%
Module-VI: Role of Design Thinking	4	13%

SYLLABUS OUTLINE:

Module I: Introduction to Design Thinking: [6L]

Importance of Design Thinking – Phases in design thinking process – Five stage model – Non-linearity of the five-stage model – Applications of design thinking in various domains

Module II: Empathize and Define Phase: [4L]

Empathy – Empathize with the users - Steps in empathize phase – Developing empathy towards people – Assuming a beginner's mindset – Ask What? And Why? – Immersion Activity – Steps in immersion activity - Body Storming – Case studies.

Module III: Ideate: [8L]

Define the problem and interpret the result – Analysis and synthesis – Personas – Four different perspectives on Personas – Steps to creating personas – Problem statement – Affinity diagrams – Empathy mapping – Point of View – "How might we" questions – Why-how laddering – Case studies. What is ideation – Need for ideation – Uses of ideation – Ideation Methods – Brainstorming – Rules for brainstorming – Mind maps – Guidelines to create mind maps – Ideation games - Six Thinking Hats – Doodling – Use of doodling in expressing creative ideas – Case studies

Module IV: Prototype: [8L]

Prototyping – Types of prototyping – Guidelines for prototyping – Story telling – Characteristics of good stories – Reaching users through stories – Importance of prototyping in design thinking – Value proposition - Guidelines to write value proposition – Case studies

Module V: Test: [6L]

Need to test –User feedback - Conducting a user test – Guidelines for planning a test – How to test - Desirable, feasible and viable solutions – Iterate phase.

Module VI: Role of Design Thinking: [4L]

Software and good design - Design thinking and coding – Agile Methodology – Differences between agile and design thinking - Complementing agile with design thinking

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires, 1st Edition, HarperCollins, 2009.
2) Eli Woolery, Design Thinking Handbook, Invision, 2019.

Reference Books:

1) Nir Eyal , Hooked: How to build habit-forming, 2014
2) Rod Judkins, The Art of Creative Thinking, Sceptre; 1st edition, 2015.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2										
CO2	2	2	3									
CO3	3	2	3									
CO4		2										
CO5	1	2										1
CO6		1	3									1
Avg.	1	1.83	1.5									0.33

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the importance of design thinking and its different phases.

CO2: Empathize with user situations and be able to define clear problem statements.

CO3: Use the different ideation methods and come with different feasible and viable ideas for solving the problem statements.

CO4: Create prototypes for clear understanding of the problem statement.

CO5: Test the created prototypes and be able to iterate if the design does not meet the customer requirement.

CO6: Complement agile process with design thinking for efficient delivery process.

INDUSTRIAL PSYCHOLOGY

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Industrial Psychology	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MDC
CODE: XXXXXX	**SEMESTER:** 5^{th}

THEORY

Learning objectives: Introduces students to the content areas of industrial psychology and the application of psychological theory to organizational issues. Topics include employment law, job analysis, recruitment and selection, training, performance appraisal and discipline, employee motivation, and workplace safety. Using an applied approach, this course will help prepare students for their roles as employees and managers.

Prerequisite: Fundamentals of Management

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction & Legal Context of Industrial Psychology	6	10%
Module-II: Identifying Criteria & Validating Tests	6	20%
Module-III: Performance Goals	6	20%
Module-IV: Motivation	6	20%
Module-V: Leadership	6	10%
Module-VI: Stress Management	6	20%

SYLLABUS OUTLINE:

Module I: Introduction & Legal Context of Industrial Psychology: [6L]

What is I/O Psychology? Research Methods, Statistics, and Evidence-based Practice, Introduction & Legal Context of Industrial Psychology, Job Analysis & Competency Modelling, Job Evaluation & Compensation, Job Design & Employee Well-Being, Recruitment

Module II: Identifying Criteria & Validating Tests: [6L]

Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods

Module III: Performance Goals: [6L]

Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance

Module IV: Motivation: [6L]

Employee Motivation, Satisfaction and Commitment, Fairness and Diversity

Module V: Leadership: [6L]

Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, the Organization of Work Behavior

Module VI: Stress Management: [6L]

Stress Management: Demands of Life and Work

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Landy, F. J. and Conte, J. M. Work in the 21st Century,2013, 4th Edition. Oxford: Blackwell Publishing.
2) Aamodt, M. Industrial/Organizational Psychology: An Applied Approach,2015, 8th Edition, Wadsworth Publishing Co.

Reference Books:

1) Miner.B, J. Industrial-Organizational Psychology. 1992, McGraw Hill Inc., US.
2) Ashwathappa, K. Human Resource Management: Text & Cases,2017,8th Edition, McGraw Hill Education

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1						1					2
CO2	1	2										1
CO3	1		3									
CO4	1	3	1									1
CO5	1	2	1									
CO6	1	2										1
Avg.	1	2	0.66	0	0	0.16						0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Become conversant about the major content areas of Industrial Psychology (i.e., job analysis, recruitment, selection, employment law, training, performance management, and health/well-being issues in the workplace).

CO2: Gain further comfort with statistical concepts in the context of making personnel decisions to reinforce content learned in PSY203 or an equivalent introductory statistics course.

CO3: Gain practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs, and employee well-being.

CO4: Deepen your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions.

CO5: Prepare for other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management.

CO6: Discuss the role of positive psychology in building effective professional relationships

COMPUTER NETWORKS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Computer Networks Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 5^{th}

List of experiments:

1) Write a program to calculate hamming distance between two bytes mechanisms
2) a) Write a C Program to implement Echo server using TCP/IP protocol.
   b) Write a C Program to implement Echo server using UDP protocol.
3) a) Write a C Program to implement Chat server using TCP/IP protocol.
   b) Write a C Program to implement Chat server using UDP protocol.
4) Write a C Program to implement Concurrent server using TCP/IP protocol.
5) Write a C Program to implement Time server using TCP/IP protocol.
6) Write a C Program to implement File server using UDP protocol.
7) Write a C Program to implement Calculator server using TCP protocol.
8) Write a C Program to implement Multicasting using UDP protocol.

SOFTWARE ENGINEERING AND AGILE METHODOLOGY LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Software Engineering and Agile Methodology Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 5^{th}

List of Practical:

1) Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives, and Infrastructure.
2) Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.
3) Data Modeling – SRS Design - Use work products – data dictionary.
4) Software Designing - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
5) Prototype model – Develop the prototype of the product.
6) The SRS and prototype model should be submitted for end semester examination.
7) Any experiment specially designed by the college (Detailed instructions for Laboratory Manual to be followed for further guidance)

MACHINE LEARNING LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Machine Learning Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 5^{th}

List of Practical:

1) Implement Decision Tree learning
2) Implement Logistic Regression
3) Implement classification using Multilayer perceptron
4) Implement classification using SVM
5) Implement Adaboost
6) Implement Bagging using Random Forests
7) Implement K-means Clustering to Find Natural Patterns in Data
8) Implement Hierarchical clustering
9) Implement K-mode clustering
10) Implement Association Rule Mining using FP Growth
11) Classification based on association rules
12) Implement Gaussian Mixture Model Using the Expectation Maximization
13) Evaluating ML algorithm with balanced and unbalanced datasets
14) Comparison of Machine Learning algorithms
15) Implement k-nearest neighbour algorithm

ADVANCED ALGORITHMS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P-S
NAME: Advanced Algorithms Lab	**COURSE CREDIT:** 01[0-0-2-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 5^{th}

List of Practical:

1) Write a program to find the minimum and maximum elements from an array.
2) Write a program to perform a binary search algorithm using recursion.
3) Write a program to find minimum and maximum elements from an array using Divide and Conquer approach.
4) Write a program to display the Fibonacci series till n numbers using recursion.
5) Write a program to perform a bubble sort algorithm using a functional approach and print the time complexity.
6) Write a program to perform a selection sort algorithm using a functional approach and print the time complexity.
7) Write a program to calculate the shortest path using prims algorithm.
8) Write a program to calculate the shortest path using the Kruskal algorithm.
9) Write a program to implement the DFS algorithm.
10) Write a program to implement the BFS algorithm.
11) Write a program to implement Matrix Chain Multiplication using DP.
12) Write a program to perform the Fractional knapsack (greedy approach) algorithm using a functional approach
13) Write a program to perform 0 - 1 knapsack (DP approach) algorithm using a functional approach
14) Write a program to calculate the shortest path using the Dijkstra algorithm (greedy approach).
15) Write a program to calculate the shortest path using Bellman Ford algorithm (DP approach).
16) Write a program to perform Job-sequence-with deadline.
17) Write a program to implement the N-Queen problem using backtracking.
18) Write a program to implement Traveling Salesman Problem.

SEMESTER-VI

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Machine Learning Operations		MC	4	3	1	0	0
2	Deep Learning and Applications/ Data Analytics and Visualization		ME	4	3	1	0	0
3	Natural Language Processing/ Cognitive Science/ Human Computer Interface		ME	4	3	1	0	0
4	NM Elective-III: Microprocessor and Microcontroller/ Information Theory and Coding		NM	4	3	1	0	0
5	Soft-Skill Development-VI		NV	1	1	0	0	0
6	Scientific and Technical Writing		NV	2	0	0	0	2
7	SEC3: Entrepreneurship Skill Development		SEC	3	2	1	0	0
8	VAC: Human Values and Ethics		VAC	2	2	0	0	0
Practical								
9	Machine Learning Operations Lab		MC	1	0	0	2	0
10	Deep Learning and Applications Lab/ Data Analytics and Visualization Lab		ME	1	0	0	2	0
Total Credit=25								

MACHINE LEARNING OPERATIONS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Machine Learning Operations	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives: On completion of the course, student will be able to: Develop Machine learning algorithm in real life problem, incorporate the judgement of data quality, allow continuous learning for deployment, maintaining the ML models, and achieve automation in real life problem solving.,

Prerequisite: Basic computer knowledge and Data Structure and Algorithm.

Course content/Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to MLOps	6	12.5%
Module-II: ML Lifecycle Management	10	20.8%
Module-III: Data Engineering for MLOps	8	16.7%
Module-IV: Model Development and Deployment	8	16.7%
Module-V: Monitoring and Maintaining ML Models	8	16.7%
Module-VI: Security, Compliance, and Ethics in MLOps	8	16.7%

SYLLABUS OUTLINE:

Module I: Introduction to MLOps: [6L]

Overview of Machine Learning Operations (MLOps), the Importance of MLOps in Modern AI/ML Workflows, Key Concepts: CI/CD for Machine Learning, Automation and Orchestration. Differences between Traditional DevOps and MLOps. Case Studies and Industry Applications. Challenges and Best Practices in MLOps

Module II: ML Lifecycle Management: [10L]

Stages of the Machine Learning Lifecycle: Data Collection, Data Preparation, Model Training, Model Evaluation, Deployment, Monitoring. Tools and Frameworks for Managing the ML Lifecycle, Version Control for Data, Code, and Models. Experiment Tracking and Management, Reproducibility and Collab-

oration

Module III: Data Engineering for MLOps: [8L]

Data Pre-processing and Feature Engineering, Data Pipelines and ETL Processes, Handling Big Data and Real-Time Data Streams, Data Storage Solutions: Databases, Data Lakes, Warehouses, Data Quality and Validation, Practical Examples and Tools.

Module IV: Model Development and Deployment: [8L]

Best Practices for Model Development, Containerization with Docker,Kubernetes for Model Deployment. Git basics - clone, pull, push, branch, commit, and merge conflicts. Model Deployment Strategies: Batch Deployment, Online Deployment, Edge Deployment. Serving Models in Production: REST APIs, gRPC and Microservices.

Module V: Monitoring and Maintaining ML Models: [8L]

Importance of Monitoring in MLOps, Tools for Monitoring Model Performance and Health. Detecting and Handling Model Drift, Retraining and Updating Models. Anomaly Detection and Alerting Systems. Practical Implementation of Monitoring Tools. Case Studies on Model Maintenance.

Module VI: Security, Compliance, and Ethics in MLOps: [8L]

Security Considerations in MLOps, Data Privacy and Compliance with Regulations (e.g., GDPR, CCPA). Ethical Implications of Machine Learning Models, Fairness, Transparency, and Accountability in AI/ML. Mitigating Bias in Machine Learning Models Ensuring Responsible AI Practices. Case Studies on Ethical Issues in MLOps.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) “Machine Learning Engineering” by Andriy Burkov
2) “Machine Learning Engineering in Action” by Ben Wilson

Reference Books:

1) Gift, N., & Deza, A. (2021). Practical MLOps. O’Reilly Media.
2) Burkov, A. (2020). Machine Learning Engineering. True Positive Inc.
3) Ameisen, E. (2020). Building Machine Learning Powered Applications. O’Reilly Media.

4) Treveil, M., Markham, T., Ayling, M., Bishop, C., Harriott, L., & McCulloch, I. (2020). Introducing MLOps: How to Scale Machine Learning in the Enterprise. O'Reilly Media.
5) Fregly, C., & Barth, A. (2021). Data Science on AWS: Implementing End-to-End Data Pipelines with AWS. O'Reilly Media.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	2	1	1	-	1	-	2
CO2	2	3	3	3	3	1	1	1	2	1	1	2
CO3	3	3	3	3	3	2	2	-	-	1	1	2
CO4	2	2	3	3	3	2	2	-	-	2	-	2
CO5	2	2	2	3	3	2	2	1	-	2	2	3
CO6	2	2	2	2	2	2	3	3	1	1	-	2
Avg.	2.3	2.3	2.7	2.7	2.7	1.8	1.8	1.2	0.5	1.3	0.7	2.2

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To be able to understand MLOps Principles.

CO2: To be able to manage the ML Lifecycle.

CO3: To be able to perform data pre-processing and data engineering in application of Data Science.

CO4: To be able to implement various model deployment strategies such as batch, online, and edge deployment.

CO5: To be able to apply practical monitoring tools and learn from case studies on model maintenance.

CO6: To be able to analyze case studies on ethical issues in MLOps to understand real-world applications and challenges.

DEEP LEARNING AND APPLICATIONS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Deep Learning and Applications	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives:

1) Understand the foundational concepts of deep learning and neural networks.
2) Implement and optimize deep neural networks using various techniques and tools.
3) Design and apply convolutional neural networks for image-related tasks.
4) Utilize recurrent neural networks for sequence modeling and text generation.
5) Explore and implement unsupervised learning and generative models.
6) Apply deep learning techniques to advanced topics and real-world applications.

Prerequisite: Linear algebra: vectors, matrices, and tensor operations; Probability and statistics, Basics of calculus: gradients and derivatives.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Artificial Neural Networks and Feedforward Neural Networks	10	21%
Module-II: Deep Neural Networks (DNNs)	10	21%
Module-III: Convolutional Neural Networks (CNNs)	10	21%
Module-IV: Recurrent neural networks (RNNs)	8	17%
Module-V: Generative Models	6	12%
Module-VI: Applications of Deep Learning	4	8%

SYLLABUS OUTLINE:

Module I: Introduction to Artificial Neural Networks and Feedforward Neural Networks: [10L]
Basics of artificial neural networks (ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks.

Feedforward neural networks: Pattern classification using perceprton, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Autoencoders

Module II: Deep Neural Networks (DNNs): [10L]
Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization).

Module III: Convolutional Neural Networks (CNNs): [10L]
Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, Training a CNNs: weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs.

Module IV: Recurrent neural networks (RNNs): [8L]
Sequence modeling using RNNs, Back propagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture.

Module V: Generative Models: [6L]
Restrictive Boltzmann Machines (RBMs), Stacking RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets.

Module VI: Applications of Deep Learning: [4L]
Applications in vision, speech and natural language processing.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Goodfellow, Ian, Bengio, Yoshua, Courville, Aaron, Deep learning, In preparation for MIT Press, Available online: http://www.deeplearningbook.org, 2016
2) Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013

Reference Books:

1) Chollet, François. Deep Learning with Python. Manning Publications, 2017.
2) Zhang, Yuxi. Hands-On Deep Learning Architectures with Python. Packt Publishing, 2019.

3) Nielsen, Michael A. Neural Networks and Deep Learning: A Textbook. Determination Press, 2015.
4) Aggarwal, Charu C. Neural Networks and Deep Learning: A Textbook. Springer, 2018.
5) Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly Media, 2019.
6) Brownlee, Jason. Deep Learning for Computer Vision: Expert Techniques to Train Advanced Neural Networks Using TensorFlow and Keras. Machine Learning Mastery, 2019.
7) Schmidhuber, Jürgen. Deep Learning in Neural Networks: An Overview. Elsevier, 2015.
8) S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2010
9) B. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	1	1	1	1	1	1
CO2	2	2	2	1	2	1	1	1	1	1	1	1
CO3	2	3	3	2	1	1	1	1	1	2	1	1
CO4	2	2	2	2	2	1	1	1	1	1	1	1
CO5	1	2	2	1	1	1	1	1	2	1	1	1
CO6	1	1	3	3	2	1	1	1	1	1	1	1
Avg	1.67	1.83	2	1.5	1.67	1	1	1	1	1	1	1

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the fundamental concepts of artificial neural networks (ANNs) and their architecture, including the computational models of neurons and the functional units used for pattern recognition tasks.

CO2: Analyze the challenges associated with training deep neural networks (DNNs) and apply various optimization and regularization techniques to improve training efficiency and model performance.

CO3: Gain proficiency in convolutional neural networks (CNNs) by understanding their architecture, training methodologies, and the ability to visualize and interpret CNN outputs in the context of image processing.

CO4: Implement and evaluate recurrent neural networks (RNNs) for sequence modeling, understanding the mechanisms of backpropagation through time and the functioning of Long Short-Term Memory (LSTM) networks.

CO5: Explore generative models, including Restricted Boltzmann Machines (RBMs) and Deep Belief Nets, to understand their architecture and learning processes for generating new data samples.

CO6: Investigate real-world applications of deep learning in vision, speech, and natural language processing, demonstrating the ability to apply deep learning techniques to solve practical problems.

DATA ANALYTICS AND VISUALIZATION

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Data Analytics and Visualization	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives:

1) **Understand the Fundamentals of Data Analytics**
   Grasp the key concepts, importance, and applications of data analytics across various industries.
2) **Develop Proficiency in Data Collection and Preparation**
   Learn methods for acquiring, cleaning, and organizing data from diverse sources to ensure accuracy and usability for analysis.
3) **Master Analytical Techniques and Tools**
   Gain expertise in applying statistical methods, machine learning algorithms, and tools such as Python, R, SQL, or Excel to analyze data effectively.
4) **Interpret and Visualize Analytical Results**
   Learn to create meaningful visualizations and interpret the insights derived from data analysis to inform decision-making.
5) **Apply Data Analytics to Solve Real-World Problems**
   Develop the ability to use data analytics techniques to address specific challenges in fields such as business, healthcare, and finance.
6) **Understand Ethical and Legal Implications of Data Use**
   Learn to handle data responsibly, adhering to ethical standards and legal regulations to ensure privacy, security, and integrity in data analytics practices.

Prerequisite: Basic computer knowledge and knowledge about Data Structure and Algorithm

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Data Analytics	8	15%
Module-II: Data Pre-processing and Cleaning	8	18%
Module-III: Exploratory Data Analysis	8	18%
Module-IV: Statistical and Predictive Analytics	8	18%
Module-V: Data Visualization and Communication	8	16%
Module-VI: Applications and Emerging Trends in Data Analytics	8	15%

SYLLABUS OUTLINE:

Module I: Introduction to Data Analytics: [8L]

Overview of Data Analytics, Definition, scope, and applications, Importance of data-driven decision-making, Types of Data Analytics, Descriptive, diagnostic, predictive, and prescriptive analytics, Data Analytics Lifecycle, Data collection, pre-processing, analysis, and visualization, Data Types and Structures, Structured, unstructured, and semi-structured data, Data Sources and Collection Techniques, Surveys, APIs, IoT devices, web scraping, and databases, Tools and Technologies in Data Analytics, Overview of tools: Python, R, Excel, and Tableau, Challenges in Data Analytics, Data privacy, ethical considerations, and biases, Case Studies in Data Analytics, Real-world examples across industries.

Module II: Data Pre-processing and Cleaning: [8L]

Importance of Data Cleaning, Impacts on analysis and decision-making, Handling Missing Values, Imputation methods, deletion strategies, Identifying and Handling Outliers, Statistical and visualization methods, Data Transformation, Normalization, scaling, and feature engineering, Data Integration, Combining datasets from different sources, Encoding Categorical Data, One-hot encoding, label encoding, and dummy variables, Data Reduction Techniques, Dimensionality reduction (PCA, feature selection), Hands-On: Pre-processing with Python or R.

Module III: Exploratory Data Analysis: [8L]

Importance of EDA, Identifying trends, patterns, and anomalies, Statistical Techniques for EDA, Measures of central tendency and dispersion, Visual Tools for EDA, Box plots, histograms, scatter plots, and heatmaps, Correlation Analysis, Pearson and Spearman correlations, Distribution Analysis, Normality tests and skewness, Feature Importance Analysis, Techniques for identifying key features, Hands-On: EDA with Python (Pandas, Matplotlib, Seaborn) or R, Case Study: EDA for Business Problem Solving.

Module IV: Statistical and Predictive Analytics: [8L]

Overview of Statistical Analysis, Hypothesis testing, confidence intervals, and p-values.Regression Analysis, Linear and multiple regression, Classification Techniques, Logistic regression, decision trees, and Naive Bayes, Clustering Techniques, K-means, hierarchical clustering, and DBSCAN, Time-Series Analysis, ARIMA models and trend forecasting, Evaluation Metrics for Predictive Models, Accuracy, precision, recall, F1-score, and ROC-AUC, Hands-On: Building Predictive Models in Python (Scikit-learn), Case Study: Predictive Analytics in Real-World Scenarios.

Module V: Data Visualization and Communication: [8L]

Principles of Effective Visualization, Clarity, simplicity, and storytelling, Tools for Visualization, Tableau, Power BI, Matplotlib, and Excel Basic Charts and Graphs, Bar charts, line charts, pie charts, and scatter plots, Advanced Visualizations, Heatmaps, geospatial maps, and dashboards, Creating Interactive Visualizations, Using Plotly and Tableau for dynamic dashboards, Communicating Insights to Stakeholders, Techniques for storytelling with data, Hands-On: Building Dashboards in Tableau or Power BI, Project: Visual Analytics for Decision-Making

Module VI: Applications and Emerging Trends in Data Analytics: [8L]

Applications in Business Analytics, Marketing, supply chain, and financial analytics, Applications in Healthcare and Education, Predictive modeling and student performance analysis, Big Data Analytics, Tools and techniques for handling large datasets, Real-Time Data Analytics, Streaming analytics and IoT applications, Ethical Considerations in Data Analytics, Privacy, bias, and transparency, Introduction to AI and Machine Learning in Analytics, Integrating AI for predictive and prescriptive analytics, Emerging Trends in Data Analytics, Cloud analytics, edge computing, and augmented analytics, Final Project Presentation Groupwise, Students showcase comprehensive analytics solutions.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Provost, F., & Fawcett, T. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media.
2) Montgomery, D. C., & Runger, G. C. (2014). Applied statistics and probability for engineers (6th ed.). Wiley.
3) Hastie, T., Tibshirani, R., & Friedman, J. (2009). The elements of statistical learning: Data mining, inference, and prediction (2nd ed.). Springer.
4) Dean, J., & Ghemawat, S. (2017). Big data analytics: Turning big data into big money. Wiley.

5) Miller, T. (2015). Modeling techniques in predictive analytics: Business problems and solutions with R. FT Press Analytics.
6) Baesens, B. (2014). Analytics in a big data world: The essential guide to data science and its applications. Wiley.

Reference Books:

1) Shmueli, G., Patel, N. R., & Bruce, P. C. (2017). Data mining for business analytics: Concepts, techniques, and applications in R. Wiley.
2) Siegel, E. (2013). Predictive analytics: The power to predict who will click, buy, lie, or die. Wiley.
3) Larose, D. T., & Larose, C. D. (2015). Data mining and predictive analytics (2nd ed.). Wiley.
4) Gupta, G. K. (2014). Introduction to data mining with case studies (3rd ed.). PHI Learning.
5) Marr, B. (2015). Big data: Using smart big data, analytics and metrics to make better decisions and improve performance. Wiley.
6) Chen, C. P., & Zhang, C. Y. (2014). Data-intensive applications, challenges, techniques, and technologies: A survey on Big Data. Springer.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	-	-	-	-	-	-	1
CO2	3	-	2	-	-	1	-	-	-	-	-	2
CO3	2	2	-	2	1	-	-	-	-	-	-	1
CO4	-	-	2	1	-	1	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	-
CO6	-	2	2	1	-	-	-	-	-	-	-	2
Avg.	1.66	1.33	1.33	0.83	0.50	0.33	-	-	-	-	-	1.0

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Students will gain the ability to utilize advanced analytical tools such as Python, R, SQL, or Excel and apply statistical and machine learning techniques to analyze datasets.

CO2: Students will demonstrate skills in data collection, cleaning, transformation, and preparation to ensure high-quality input for analysis.

CO3: Students will interpret analytical results, identify patterns, and draw actionable insights to support data-driven decision-making processes.

CO4: Students will create compelling data visualizations and reports that effectively convey findings to both technical and non-technical audiences.

CO5: Students will apply data analytics techniques to solve practical problems in domains such as business, healthcare, finance, and technology.

CO6: Students will integrate ethical considerations and adhere to legal frameworks when handling, analyzing, and interpreting data.

NATURAL LANGUAGE PROCESSING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Natural Language Processing	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives: Introduce to some of the problems and solutions of NLP and their relation to linguistics and statistics.

Prerequisite: Courses include data structures, algorithms, machine learning & python programming. Students should have basic knowledge of formal language.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	6	12%
Module-II: Linguistic Resources	10	21%
Module-III: Parts of Speech Tagging	8	17%
Module-IV: Parsing & Discourse	8	17%
Module-V: Feature Engineering	8	17%
Module-VI: Language Models	8	16%

SYLLABUS OUTLINE:

Module I: Introduction: [6L]

Human languages, ambiguity, phases in natural language processing, applications. Text representation in computers, encoding schemes. Text preprocessing.

Module II: Linguistic Resources: [10L]

Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, NLTK.Meaning representation, semantic analysis, lexical semantics. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology. N-grams.

Module III: Parts of Speech Tagging: [8L]

Stochastic POS tagging, HMM, Handling of unknown words, named entities, multi word expressions. Natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.

Module IV: Parsing & Discourse: [8L]

Unification, probabilistic parsing. Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure. Named entity recognition.

Module V: Feature Engineering: [8L]

Bag-of-word: Tf/IDF, Count vector; Vector space Model; Latent semantic Analysis; Word embedding; Word2Vec; Glove; Sentence embedding Technique: Doc2Vec; PCA, Factor Analysis.

Module VI: Language Models: [8L]

Latent Dirichlet Allocation (LDA), Non-negative Matrix Factorization (NMF).Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems. Case Studies.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) James A., Natural language Understanding 2e, Pearson Education, 1994
2) Bharati A., Sangal R., Chaitanya V. Natural language processing: a Paninianperspective, PHI, 2000
3) Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP, 2008

Reference Books:

1) Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									
CO2	3	2	3		3							
CO3	3	3	3									
CO4	3	3	3									
CO5	3	3	3		2		2		2			
CO6	3	3	3									
Avg.	3	2.5	2.5		0.83		0.33		0.33			

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the Fundamentals of Natural Language Processing.

CO2: Utilize Linguistic Resources and Tools for NLP.

CO3: Apply POS Tagging and Language Grammar Concepts.

CO4: Analyze and Implement Parsing Techniques and Discourse Understanding.

CO5: Design Feature Engineering Techniques for Text Representation.

CO6: Develop Language Models and explore Modern Applications in NLP.

COGNITIVE SCIENCE

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Cognitive Science	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives:

1) To understand the way in which cognitive science is methodologically distinctive while at the same time is an interdisciplinary field where established fields of research—including Psychology, Computer Science, Linguistics, Neuroscience.
2) To develop skills in analyzing, interpreting, and assessing the empirical data and research techniques that contribute to cognitive science.
3) To understand central modeling techniques in cognitive science, including traditional computational approaches, neural network/deep learning approaches, and dynamical approaches.

Prerequisite: Basic knowledge of Artificial Intelligence.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Foundational Areas of Analytics	6	12%
Module-II: Foundational Areas of Cognitive Science	4	8%
Module-III: Data Theory & Taxonomy of Data	6	13%
Module-IV: Multivariate Data Analytics & Cognitive Analytics	10	21%
Module-V: Artificial Intelligence & Machine Learning	12	25%
Module-VI: Approach & Methodology	10	21%

SYLLABUS OUTLINE:

Module I: Foundational Areas of Analytics: [6L]

Introduction to Analytics: Definition, Description & Evolution of Analytics, History of Analytics, and Applicability of Analytics with development of Technology and Computer, How Analytics entered mainstream. Concepts of Analytics: Various overlapping concepts and fields of Analytics such as Data Mining,

Machine Learning, Artificial Intelligence and SimulationEmerging Areas in Analytics: Understanding of emerging research areas of Analytics: Mathematical programming, Evolutionary computation, Simulation, Machine learning/data mining, Logic-based models, and, Combinations of categoriesValue Chain of Analytics: Descriptive Analytics Covering Exploratory Data Analysis & Basic of Statistics, Diagnostics Analytics: BI/Analysis, Trend, Pattern, Simultaneous Relationship, Predictive Analytics: Cause-Effect Relationship and Futuristic prediction in terms of probabilities, Continuous & Categorical Predictions, Simulation, Optimization, Multi-faceted Intelligent Technology driven Analytics combining Machine Intelligence with Human Brain Processing Abilities

Module II: Foundational Areas of Cognitive Science: [4L]

Introduction & Evolution of Cognitive Science: Introduction to the study of cognitive sciences, Brief history of cognitive science development and Methodological concerns in philosophy Understand Brain and Sensory Motor Information: Fundamentals of Neuro Science, Processing of sensory information in the brain, and Brain Imaging Elements Language & Linguistic Knowledge: Background and details of Syntax & Semantics, Understanding of Generative Linguistic Memory & Processing: Theory of Information Processing, Fundamentals of Short term Memory

Module III: Data Theory & Taxonomy of Data: [6L]

Data as a whole: Understanding of Data as a whole for distinguishing and relating various types of data and Categorization of Data: Structured, Unstructured Data, Quantitative & Qualitative Data. Views of Data: Understanding Data as an interdisciplinary framework for learning methodologies: covering statistics, neural networks, and fuzzy logic. Measurement & Scaling Concepts: Measurement of variables and commonly used statistical tools: Number of procedures for measurement of the variables, Categorization procedures, Scale construction procedures and Techniques of data processing for qualitative as well as quantitative data; Various types of Scales: Nominal, Ordinal, Interval & Ratio Scales

Module IV: Multivariate Data Analytics & Cognitive Analytics: [10L]

Overview: High level overview of Categorization of Techniques: Inter-dependence Relationship Techniques and Dependence Relationship Techniques, Overview of Commonly Used Inter-dependence Techniques: Factor Analysis, Principal Component Analysis (PCA), Cluster Analysis: Overview of Commonly Used Dependence Techniques: Regression, Logistic RegressionAnalytics Value Chain & Application of Analytics across.

Value Chain:Basic statistical concepts such as Descriptive & Diagnostics statistics, concept of random variables, discrete and continuous random variables, confidence interval, hypothesis testing, analysis of variance and correlation. Predictive analytics techniques such as multiple linear regression, logistic regression, decision tree learning Clustering and forecasting techniques.Prescriptive analytics Concepts: linear programming, integer programming, goal programming & stochastic models. Cognitive analytics Concepts: Text Analytics, Learning Analytics, Data Mining, Cognitive Systems, Cognitive Computing,

Learning Data Science, Machine Learning, Big data Analytics and Business analytics.

Module V: Artificial Intelligence & Machine Learning: [12L]

Fundamentals of Artificial Intelligence: Various areas of AI: Knowledge: Text Analytics, Topic Modelling, Natural Language Processing (NLP), Natural Language Generation (NLG), Natural Language Understanding (NLU), Named-entity recognition (NER), Perception: Image Analytics, Video Analytics & Audio Analytics, Memory: Cognitive Engagement: BOTs, Virtual & Digital Assistants, Augmented Reality, Virtual Reality, Mixed Reality, Learning: Intelligent Automation Spectrum of AI Reactive Machine: Low memory, works on Known rules, such as Object Detection/Games/Recommendations specific to known Rules, Limited Memory: Memory used to learn and improve continuously such as Most ML Models, Automated Vehicles, Theory of Mind: Machine Understands and responds such as BoTs/Virtual/Digital Assistants, Self-Aware: Human like intelligence such as Super Robots in Space etc.

Module VI: Approach & Methodology: [10L]

World Standard Methodology: CRISP-DM Methodology, SEMMA Methodology, Real Life Work around Multi-Variate Analytics: A few Selected Commonly used Techniques: Predictive & Classification Models, Regression, Clustering, Real Life Work around Artificial Intelligence, Machine Learning and Deep Learning: A few Selected Commonly used Techniques & Algorithms: ANN (Artificial Neural Network), CNN (Convolutional Neural Network), RNN (Recurrent Neural Network); RN Architecture: LSTM, Bidirectional LSTM, Gated Recurrent Unit (GRU), CTRNN (Continuous Time RNN) CNN Architectures: VGG16, Alexnet, InceptionNet, RestNet, Googlenet, Object Detection models: R-CNN, Fast R-CNN, Faster R-CNN, cascade R-CNN. Mask RCNN, Single Shot MultiBox Detector (SSD).

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Jose Luis Bermudez, “Cognitive Science: An Introduction to the Science of the Mind”, 2020 Cambridge University Press, New York.

Reference Books:

1) Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2018). Cognitive Neuroscience: The Biology of the Mind (5th ed.). W.W. Norton & Company.
2) Eysenck, M. W., & Keane, M. T. (2015). Cognitive Psychology: A Student’s Handbook (7th ed.). Psychology Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	1	-	-	-	-	-	-
CO2	3	3	3	2	1	1	-	-	-	-	-	1
CO3	3	3	3	3	2	1	-	-	-	-	-	-
CO4	3	3	3	2	1	1	-	-	-	-	-	-
CO5	3	3	3	2	1	1	-	-	-	-	-	-
CO6	3	3	3	3	2	-	-	-	-	-	-	-
Avg.	3	3	3	2.16	1.16	0.8	-	-	-	-	-	0.16

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To understand the basic principles and process of cognitive science

CO2: Learn and understand the learning model and apply the same to appropriate real world applications

CO3: To demonstrate qualitative and quantitative skill and critical thinking on cognitive science by applying suitable methodology to real world applications

CO4: Students will understand and apply declarative and logic models

CO5: Envisage the concept of cognitive learning

CO6: To demonstrate the acquired inter-disciplinary knowledge in language processing and application of different research approaches with cognitive science

HUMAN COMPUTER INTERFACE

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Human Computer Interface	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives:

1) To provide the basic knowledge on the levels of interaction, design models, techniques and validations focusing on the different aspects of human-computer interface and interactions
2) To make the learners to think in design perspective and to evaluate interactive design
3) To use the concepts and principles of HCI to analyse and propose solution for real-life applications
4) To become familiar with recent technology trends and challenges in HCI domain.

Prerequisite: The students should have basic programming knowledge.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: HCI Foundations	8	20%
Module-II: Designing Interaction	8	20%
Module-III: Interaction Design Models	8	20%
Module-IV: Guide Lines in HCI	8	20%
Module-V: Collaboration and Communication	8	20%
Module-VI: Human Factors and Security	8	20%

SYLLABUS OUTLINE:

Module I: HCI Foundations: [8L]

Input–output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning

Module II: Designing Interaction: [8L]

Overview of Interaction Design Models, Discovery - Framework, Collection - Observation, Elicitation, Interpretation - Task Analysis, Storyboarding, Use Cases, Primary Stakeholder Profiles, Project Management Document

Module III: Interaction Design Models: [8L]

Model Human Processor- Working Memory, Long-Term Memory, Processor Timing, Keyboard Level Model- Operators, Encoding Methods, Heuristics for M Operator Placement, What the Keyboard Level Model Does Not Model, Application of the Keyboard Level Model, GOMS- CMN- GOMS Analysis, Modelling Structure, State Transition Networks- Three- State Model, Glimpse Model, Physical Models, Fitts' Law

Module IV: Guide Lines in HCI: [8L]

Shneideman's eight golden rules, Norman's Sever principles, Norman's model of interaction, Nielsen's ten heuristics, Heuristic evaluation, contextual evaluation, Cognitive walk-through

Module V: Collaboration and Communication: [8L]

Face-to-face Communication, Conversation, Text-based Communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design.

Module VI: Human Factors and Security: [8L]

Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware Implementing synchronous groupware, Mixed, Augmented and Virtual Reality.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers,2008

Reference Books:

1) Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							
CO2	3	3	3	1	1							1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5	0.3							0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Enumerate the basic concepts of human, computer interactions

CO2: Create the processes of human computer interaction life cycle

CO3: Analyse and design the various interaction design models

CO4: Apply the interface design standards/guidelines for evaluating the developed interactions

CO5: Establish the different levels of communication across the application stakeholders

CO6: Apply product usability evaluations and testing methods

MICROPROCESSOR AND MICROCONTROLLER

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Microprocessor and Microcontroller	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives:

At the end of completing this course, students will learn to develop an understanding of the operations of microprocessors and microcontrollers; machine language programming and interfacing technique

Prerequisite: The students should have Computer Organization basics.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Overview	8	17%
Module-II: Introduction to 8085	8	17%
Module-III: Concept of Interrupts	6	12%
Module-IV: Interfacing with Peripheral Devices	10	21%
Module-V: Intel 8051 Microcontroller	10	21%
Module-VI: DMA Controller	6	12%

SYLLABUS OUTLINE:

Module I: Overview: [8L]

Overview of Microcomputer systems and their building blocks – Intel 8085 Microprocessor Unit (MPU) Architecture – Interfacing with Memory and I/O Devices

Module II: Introduction to 8085: [8L]

Introduction to 8085: Instruction Set and Assembly Language Programming (ALP), Counters and Time Delays, Stack and Subroutines

Module III: Concept of Interrupts: [6L]

Concept of Interrupts and Direct Memory Access

Module IV: Interfacing with Peripheral Devices: [10L]

Interfacing with Peripheral Devices – D/A and A/D Converters, Parallel I/O, Timer – Serial I/O and Data Communication, Application / System Level Interfacing Design

Module V: Intel 8051 Microcontroller: [10L]

Introduction to Single-chip Microcomputer / Intel 8051 Microcontroller Architecture and Programming. Trends in Microprocessor Technology: Introduction to Intel 8086 / 8088 – Arithmetic Coprocessor, Advanced Coprocessor Architecture -286, 486, Pentium - Introduction to RISC Processors.

Module VI: DMA Controller: [6L]

Keyboard Interface controller-8279, DMA Controller

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 2013/2015
2) . D. A. Patterson and J H Hennessy, ”Computer Organization and Design: The hardware and software interface. Morgan Kaufman Publishers

Reference Books:

1) Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							
CO2	3	3	3	1	1							1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5	0.3							0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the internal architecture and organization of 8086

CO2: Analyse the Assembly language programs of 8086

CO3: Analyse the internal architecture and real time control of 8051

CO4: Discuss the input /output, memory interface, Serial Communication and Bus Interface devices

CO5: Analyse the internal architecture of ARM Processors

CO6: Classify the internal architecture of CORTEX ARM Processor and MAP ARM Processor

INFORMATION THEORY AND CODING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Information Theory and Coding	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives: This course gives brief knowledge about the basic algebraic relationships of entropy, relative entropy, and mutual information. In this course students are going to learn how to compress the data using source coding and how to make data transmission reliable using channel coding. It introduces the basic principles of encoding, decoding, error detecting and error correcting techniques.

Prerequisite: The students should have Computer Organization basics.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Basics of information theory	4	8%
Module-II: Channels	6	12%
Module-III: Error Correction	8	17%
Module-IV: Linear block codes	8	17%
Module-V: Cyclic Codes Polynomials	10	21%
Module-VI: BCH Codes and Tree CODES	12	25%

SYLLABUS OUTLINE:

Module I: Basics of information theory: [4L]

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

Module II: Channels: [6L]

Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module III: Error Correction: [8L]

Introduction to Error Control Coding: Need for error control in digital communication, types of errors

(random errors, burst errors). Error Detection: Parity check, CRC (Cyclic Redundancy Check). Error Correction Codes: Types of error-correcting codes, Hamming distance, and minimum distance. Single-Bit Error Correction and Detection: Hamming codes, syndrome decoding, and error detection techniques. Automatic Repeat Request (ARQ): Stop-and-wait ARQ, Go-back-N ARQ, Selective Repeat ARQ.

Module IV: Linear block codes: [8L]

Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.

Module V: Cyclic Codes Polynomials: [10L]

Cyclic Codes Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes. CRC (Cyclic Redundancy Check): Application of cyclic codes in CRC, generation, and detection of CRC codes. Error Detection and Correction using Cyclic Codes: Decoding techniques, error syndrome calculation, performance analysis.

Module VI: BCH Codes and Tree CODES: [12L]

BCH Codes, Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes, Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) N. Abramson, Information and Coding, McGraw Hill, 1963.
2) M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

Reference Books:

1) R.B. Ash, Information Theory, Prentice Hall, 1970

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							
CO2	3	3	3	1	1							1
CO3	3	3	3									1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.33	0.33							0.83

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand entropy by measure of information content of the message

CO2: Apply entropy and oder of information sources to analyze Markov model

CO3: Understand uniqueness of code using Kraft Inequality and prefix code

CO4: Understand the conversion of information into binary sequence using Shanon, Shanon Fano and Huffman encoding algorithms

CO5: Model continuous and discrete communication channels using input, out and joint probability matrix

CO6: Determine channel capacity of binary symmetric and binary erasure channels using mutual information and Muroga's theorem

SOFT-SKILL DEVELOPMENT-VI

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Soft-Skill Development-VI	**COURSE CREDIT:** 01[1-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: MVSSU122T06	**SEMESTER:** 6^{th}

THEORY

Learning objectives: To equip participants with essential skills required in professional settings, focusing on aptitude, logic, and reasoning. To practice creating and delivering effective business presentations. To engage in mock group discussions and gain a comprehensive understanding of corporate and social etiquette.

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No of lecture/Contact hour	Weightage (%)
Module-I: Mock Test and Practice Sessions	6	25%
Module-II: Social Etiquette	5	20%
Module-III: Business Presentation	6	25%
Module-IV: Group Discussions	7	30%

SYLLABUS OUTLINE:

Module I: Mock Test and Practice Sessions: [6L]

- Aptitude, Logic, and Reasoning

Module II: Social Etiquette: [5L]

- Power Dressing
- Fine Dining
- Office Party Etiquette
- Business Travel Etiquette

Workplace and Business Etiquette

- Proper Greetings

- Thank You Notes
- Voice mail Etiquette
- Business Salutation Etiquette
- Guest Etiquette
- Cubicle Etiquette
- Business Card Etiquette

Different Cultural Etiquette & Protocol

Module III: Business Presentation: [6L]

- 777 Rule
- Audio & Visual
- Know Your Audience
- Body Language During Presentations
- How to Handle Questions

Module IV: Group Discussions: [7L]

- Practice sessions

- ***Pedagogy for Course Delivery:*** Workshop, Group Discussions, Presentations, Lectures.
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	2	3
CO2	-	-	-	-	-	-	-	-	2	3	2	3
CO3	-	-	-	-	-	-	-	-	1	3	2	3
CO4	-	-	-	-	-	-	-	-	2	3	2	3
CO5	-	-	-	-	-	-	-	-	1	3	1	3
CO6	-	-	-	-	-	-	-	-	2	3	2	3
Avg.	-	-	-	-	-	-	-	-	1.33	3	1.83	3

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: To equip participants with essential skills in aptitude, logic, and reasoning for professional settings.

CO2: To practice creating and delivering impactful business presentations effectively.

CO3: To engage in mock group discussions to refine communication and teamwork skills.

CO4: To gain a comprehensive understanding of corporate and social etiquette.

CO5: To develop strong logical and analytical reasoning skills for problem-solving.

CO6: To improve overall professional communication skills, including presentations and group interactions.

SCIENTIFIC AND TECHNICAL WRITING

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P-S
NAME: Scientific and Technical Writing	**COURSE CREDIT:** 02[1-0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives: On completion of the course, student will:

1) Understand that how to improve your writing skills and level of readability
2) Learn about what to write in each section
3) Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Prerequisite: Fundamentals of English Grammar

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Planning and Preparation	4	20
Module-II: Structure of the Paper	4	10
Module-III: Key Skills	4	20
Module-IV: Results and Discussion	4	20
Module-V: Submission	4	20
Module-VI: Guest Lecture from R& D organizations	4	10

SYLLABUS OUTLINE:

Module I: Planning and Preparation: [20L]

Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II: Structure of the Paper: [10L]

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Review of the Literature, Methods, Results, Discussion, Conclusions,

The Final Check.

Module III: Key Skills: [20L]

Key skills are needed when writing a Title; key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module IV: Results and Discussion: [20L]

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Module V: Submission: [20L]

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Module VI: Guest Lecture from R& D organizations: [10L]

Contemporary Issues.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Goldbort R (2006) Writing for Science, Yale University Press.

Reference Books:

1) Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
2) “Technical Communication” by Mike Markel and Stuart A. Selber
3) “Technical Writing for Engineers & Scientists” by Leo Finkelstein
4) “Scientific Writing and Communication: Papers, Proposals, and Presentations” by Angelika H. Hofmann
5) “The Elements of Style” by William Strunk Jr. and E.B. White
6) “The Craft of Scientific Writing” by Michael Alley
7) “The Chicago Manual of Style” by The University of Chicago Press Editorial Staff

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	3	3	1								1
CO3	3	3	3	2								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5								0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Reflect on their previous writing experiences and enhance their current and future learning

CO2: Interpret, summarize, and critique academic texts.

CO3: Gather, evaluate, and synthesize information from different academic sources

CO4: Use a process writing approach: from planning to drafting and revising, to create different genres of academic texts

CO5: Identify good academic writing practices and adopt such practices to maintain academic honesty and avoid plagiarism during the writing process

CO6: Demonstrate effective reading and listening skills to synthesize and draw intelligent inferences

ENTREPRENEURSHIP SKILL DEVELOPMENT

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Entrepreneurship Skill Development	**COURSE CREDIT:** 03[2-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** SEC
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives: The objectives of the course are to

1) Introduce various qualities required for entrepreneurship
2) Explain various entrepreneurship models
3) Organize interaction with successful entrepreneurs
4) Introduce to various tools as examples Six hat techniques

Prerequisite: Understanding of basic marketing and general awareness.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Identify qualities of entrepreneurs	8	17%
Module-II: Write project proposal	10	20%
Module-III: Use various entrepreneurship models	8	17%
Module-IV: Understand various schemes supporting entrepreneurship	8	17%
Module-V: Think creative and innovative	8	17%
Module-VI: Future of entrepreneur in India	6	12%

SYLLABUS OUTLINE:

Module I: Identify qualities of entrepreneurs: [8L]

Understanding the meaning of Entrepreneurship, Characteristics of an Entrepreneur, Classification of Entrepreneurs, Entrepreneurial Scene in India, Factors influencing Entrepreneurship.

Module II: Write project proposal: [10L]

Entrepreneurial growth - Role played by government and Non-Government agencies

Module III: Use various entrepreneurship models: [8L]

How to enter into Market - Business idea generation Techniques- Identification of Business Opportunities- Marketing Feasibility- Financial Feasibility- Technical - Legal- Managerial and Locational Feasibility.

Module IV: Understand various schemes supporting entrepreneurship: [8L]

Project Appraisal, Preparation of Business Plan, Content of a Business Plan, Project Report.

Module V: Think creative and innovative: [8L]

Franchising and Acquisition, Product Strategies, Pricing Strategies, Distribution Strategies, Promotional Strategies, Understanding the growth Stage.

Module VI: Future of entrepreneur in India: [6L]

Future of entrepreneur in India

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Dr. Gupta and Dr. Srinivasan, Entrepreneurship development in India
2) Vasant Desai, Dynamics of Entrepreneurial Development and Management
3) Sarugadharan and Resia Begum, Women Entrepreneurship; institutional support and problems

Reference Books:

1) VenkateshwaraRao and UdaiPareek,(Eds)Developing Entrepreneurship-A Handbook
2) Raja Gopal, Agriculture Business and Entrepreneurship

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	2	-	2	-	-
CO2	-	-	-	-	-	3	3	3	-	3	-	1
CO3	-	-	-	-	-	3	2	3	-	3	-	1
CO4	-	-	-	-	-	3	2	3	-	3	-	1
CO5	-	-	-	-	-	3	2	3	-	3	-	1
CO6	-	-	-	-	-	3	3	3	-	2	-	1
Avg	-	-	-	-	-	2.83	2.33	2.83	-	2.66	-	0.83

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Explain the background of different Entrepreneur.

CO2: Utilize Entrepreneurial growth.

CO3: Understand how to enter into Market.

CO4: Understand Project Appraisal.

CO5: Utilize different technique of risk management.

CO6: Illustrate future of entrepreneur in India.

HUMAN VALUES AND ETHICS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Human Values and Ethics	**COURSE CREDIT:** 02[2-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** VAC
CODE: XXXXXX	**SEMESTER:** 6^{th}

THEORY

Learning objectives: The learning objectives of human values and ethics aim to develop an individual's understanding of moral principles, cultivate ethical decision-making skills, and encourage responsible behavior by fostering awareness of core human values like honesty, integrity, compassion, justice, and respect, enabling them to apply these values in personal and professional life situations.

Prerequisite: Nil

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Ethics and Human Values	8	20%
Module-II: Professional Ethics and Engineering	6	16%
Module-III: Case Studies-Engineering Ethical Dilemmas	2	8%
Module-IV: Social Responsibility and Sustainability	10	25%
Module-V: Ethical Decision Making Frameworks	6	16%
Module-VI: Leadership and Ethics	4	15%

SYLLABUS OUTLINE:

Module I: Introduction to Ethics and Human Values: [L]

Definition and Nature of Ethics: Ethics vs. Morals, Ethical Theories (Utilitarianism, Deontology, Rights and Virtues), Ethical Dilemmas and Decision-Making

Human Values: Core Human Values (Truth, Honesty, Integrity, Compassion, Justice, Equality) Importance of Values in Personal and Professional Life.

Module II: Professional Ethics and Engineering: [L]

Engineering Ethics: Codes of Ethics (IEEE, ASCE), Ethical Responsibilities of Engineers (Safety, Quality, Environmental Protection), Intellectual Property Rights (IPR), Conflict of Interest

Module III: Case Studies-Engineering Ethical Dilemmas: [L]

Analysis of real-world engineering ethical dilemmas (e.g., Bhopal Gas Tragedy, Challenger Disaster)

Module IV: Social Responsibility and Sustainability: [L]

Social Issues and Engineering: Poverty, Inequality, Environmental Degradation, Role of Engineers in addressing social challenges

Sustainable Development: Principles of Sustainability, Environmental Ethics, Green Engineering and Technologies

Module V: Ethical Decision Making Frameworks: [L]

Utilitarian approach, Rights-based approach, Justice-based approach, Developing critical thinking and problem-solving skills, Corporate Governance

Module VI: Leadership and Ethics: [L]

Ethical leadership qualities, Leading with integrity and values, Developing ethical leadership culture across the organization.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) "Professional ethics and values" - M. Govindarajan, S. Natarajan and V. S. Senthikumar,.
2) "Human values and professional ethics"-B S Raghavan

Reference Books:

1) Professional Ethics and Human Values, R S Naagarazan
2) Ethics and Human Values in Engineering Practices-Subrata Das
3) Global Engineering Ethics - M.S. Pritchard
4) Engineering Ethics: A Practical Guide -Charles E. Harris, Jr.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	2	3	-	-	-	2
CO2	2	3	2	2	2	2	-	3	-	2	2	2
CO3	3	3	2	3	2	2	3	3	2	2	2	3
CO4	2	2	-	2	2	3	3	3	-	-	2	2
CO5	-	3	2	3	2	-	2	3	-	3	3	3
CO6	-	-	-	-	-	3	2	3	3	3	3	2
Avg.	1.5	2.16	1	1.67	1.33	1.67	2	3	0.83	1.83	2	2.33

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the fundamental concepts of ethics, ethical theories, and their applications in decision-making and human values.

CO2: Analyze the ethical responsibilities of engineers, including professional ethics, codes of conduct, and intellectual property rights.

CO3: Evaluate real-world engineering ethical dilemmas through case studies and apply ethical principles to resolve them.

CO4: Assess the role of engineers in addressing social challenges and promoting sustainable development through ethical engineering practices.

CO5: Develop ethical decision-making skills using various ethical frameworks and approaches to corporate governance.

CO6: Demonstrate leadership skills with ethical values and integrity, fostering a culture of ethical leadership in organizations.

MACHINE LEARNING OPERATIONS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Machine Learning Operations Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** MC
CODE: XXXXXX	**SEMESTER:** 6^{th}

List of Practical:

1) MLOps & Version Control
2) What is DevOps and MLOps
3) What is CI and CD why do we need them?
4) What is version control - git basics - clone, pull, push, branch, commit, merge conflicts
5) Docker - Need for containerisation of applications
6) How to setup a docker container
7) How to mount volumes and enable ports within docker
8) How to write a docker compose file
9) CI & DVC - Github actions - Data Version Control - DVC Pipelines
10) MLOps Tools and ML Deployment - Jenkins - Dags Hub - Weights and Biases or Mlflow
11) Basics of python flask for web deployment

DEEP LEARNING AND APPLICATIONS LAB

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Deep Learning and Applications Lab	**COURSE CREDIT:** 01[0-0-2]
DEPARTMENT: Computer Science	**CATEGORY:** ME
CODE: XXXXXX	**SEMESTER:** 6^{th}

List of Practical:

1) Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras
   - Google Colaboratory - Cloning GitHub repository, Upload Data, Importing Kaggle's dataset, Basic File operations.
   - Implementing Perceptron,
   - Digit Classification : Neural network to classify MNIST dataset
2) Hyper parameter tuning and regularization practice -
   - Multilayer Perceptron (BPN)
   - Mini-batch gradient descent
3) Convolution Neural Network application using Tensorflow and Keras,
   - Classification of MNIST Dataset using CNN
   - Face recognition using CNN
4) Object detection using Transfer Learning of CNN architectures
5) Image denoising (Fashion dataset) using Auto Encoders
   - Handling Color Image in Neural Network aka StackedAuto Encoders (Denoising)
6) Text processing, Language Modeling using RNN
7) Transfer Learning models for classification problems
8) Sentiment Analysis using LSTM
9) Image generation using GAN

FOURTH YEAR

SEMESTER-VII

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Digital Transformation for Sustainable Society		NV	2	2	0	0	0
2	Project-I / Image Processing and Pattern Recognition		Project	4	0	0	0	8
3	Summer Internship		INT	4	0	0	0	8
4	NM Elective-IV: Wireless and Mobile Communication / Satellite Communication		NM	4	3	1	0	0
				Total Credit=14				

IMAGE PROCESSING AND PATTERN RECOGNITION

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P-S
NAME: Image Processing and Pattern Recognition	**COURSE CREDIT:** 04[0-0-0-8]
DEPARTMENT: Computer Science	**CATEGORY:** Project
CODE: XXXXXX	**SEMESTER:** 7^{th}

THEORY

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

1) Understand the fundamentals of image processing
2) Gain proficiency in using various image transformation methods for different applications.
3) Understand the principles of image segmentation and feature extraction techniques.
4) Learn the foundations of pattern recognition, including supervised and unsupervised learning techniques, and apply classification algorithms.
5) Apply image processing and pattern recognition concepts to solve real-world problems, including object detection, image classification, and face recognition.
6) Understand and implement advanced techniques such as texture analysis, shape-based recognition, and machine learning models for complex image data interpretation.

Prerequisite: Foundational understanding of linear algebra, calculus, and probability theory.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Image processing	10	21%
Module-II: Image Enhancement Techniques	8	17%
Module-III: Image Segmentation	8	17%
Module-IV: Image Registration and Colour image processing	6	12%
Module-V: Morphological Operations	6	12%
Module-VI: Pattern Recognition	10	21%

SYLLABUS OUTLINE:

Module I: Introduction to Image processing: [10L]

Introduction: Image definition and its representation. Image representation: pixel, resolution, bit-depth, and color models (RGB, CMY, HSV, etc.). Image processing systems and its applications. Image formation: Geometric and photometric models; Digitization - sampling, quantization; neighbourhood metrics.

Image Transforms: Fourier transform (2D DFT and inverse DFT). Discrete cosine transform (DCT) and its application in compression, Wavelet transform and multi-resolution analysis.

Image Filtering: Spatial filtering (linear, non-linear filtering), Smoothing filters (mean filter, Gaussian filter), Sharpening filters (Laplacian, gradient filters (Sobel, Prewitt)), Frequency domain filtering (low-pass and high-pass filters).

Module II: Image Enhancement Techniques: [8L]

Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.

Module III: Image Segmentation: [8L]

Pixel-Based Segmentation: Grey level thresholding- Global and local thresholding, Optimum thresholding (Bayes analysis, Otsu method);

Region-Based Segmentation: Region growing-based segmentation, Region splitting, Region merging, Split and merge technique;

Edge-Based Segmentation: Edge Detection (Derivative-based edge detection operators), Edge detection and linking, Edge operators; Line Detection and Corner Detection: Line detection techniques (Hough transform and convolution-based techniques), Corner detection techniques.

Module IV: Image Registration and Colour image processing: [6L]

Image Registration: Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.

Colour image processing: Fundamentals of different colour models - RGB, CMY, HSI, YCbCr; False colour; Pseudo colour;

Module V: Morphological Operations: [6L]

Morphological Operations Basics of Set Theory; Morphological Filtering Basics: Dilation and Erosion Operators, Top Hat Filters; Structuring Element; Opening and Closing; Hit or Miss Transformation. Representation and Description Representation- Boundary, Chain codes, Polygonal approximation approaches, Boundary segments.

Module VI: Pattern Recognition: [10L]

Feature Extraction Techniques: Boundary descriptors (shape signatures, Fourier descriptors), Region descriptors (area, perimeter, moment invariants), Texture features (gray level co-occurrence matrix, Gabor filters).

Pattern Recognition Techniques: Introduction, Supervised vs. unsupervised learning: k-nearest neighbors, support vector machines, clustering techniques (k-means, hierarchical clustering).

Template Matching: Cross-correlation, normalized cross-correlation. Feature-based matching: SIFT, SURF, and ORB features. Shape Representation and Object Recognition: Contour-based shape representation, Principal component analysis (PCA) for object recognition, Object matching using features and descriptors.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Digital Image Processing. R. C. Gonzalez and R. E. Woods, Prentice Hall.

Reference Books:

1) Image Processing: The Fundamentals. Maria Petrou and Panagiota Bosdogianni, John Wiley & Sons, Ltd.
2) Digital Image Processing. K. R. Castleman:, Prentice Hall, Englewood Cliffs.
3) Visual Reconstruction. A. Blake and A. Zisserman, MIT Press, Cambridge.
4) Digital Pictures. A. N. Netravali and B. G. Haskell, Plenum Press.
5) Digital Images and Human Vision. A. B. Watson:, MIT Press, Cambridge.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	-	-	-	-	-	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	2	3	2	2	3	1	-	-	-	-	-	1
CO4	3	2	3	3	3	2	-	-	-	-	-	2
CO5	3	3	2	2	3	1	-	-	-	-	-	1
CO6	3	3	3	3	3	2	-	-	-	-	-	2
Avg.	2.83	2.67	2.5	2.17	2.67	1.33	-	-	-	-	-	1.5

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand image representation, transforms, and filtering techniques for image enhancement and analysis.

CO2: Apply various image enhancement techniques, including contrast stretching, filtering, and convolution.

CO3: Perform image segmentation using pixel-based, region-based, and edge-based techniques for object detection.

CO4: Implement image registration methods and process color images using different color models.

CO5: Analyze and process images using morphological operations and representation techniques.

CO6: Extract features and apply pattern recognition techniques for object recognition and classification.

WIRELESS AND MOBILE COMMUNICATION

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Wireless and Mobile Communication	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 7^{th}

THEORY

Learning objectives:

1) To familiarize the concepts related to cellular communication and its capacity.
2) To acquaint with different generations of mobile networks.
3) To teach the fundamentals of multipath fading and propagation models.
4) To describe the modulation and diversity schemes as applied in mobile communication.

Prerequisite: The students should have analog and digital communication basics.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Cellular Communication Fundamentals	8	17%
Module-II: Spectral efficiency analysis	8	17%
Module-III: Mobile Radio Propagation	10	20%
Module-IV: Equalization	8	17%
Module-V: Code Division Multiple Access	8	17%
Module-VI: Higher Generation Cellular Standards	6	12%

SYLLABUS OUTLINE:

Module I: Module Name: [8L]

Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

Module II: Spectral efficiency analysis: [8L]

Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Module III: Mobile Radio Propagation: [10L]

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Module IV: Equalization: [8L]

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Module V: Code Division Multiple Access: [8L]

Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Module VI: Higher Generation Cellular Standards: [6L]

3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) V. K. Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
2) V. K. Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.

Reference Books:

1) Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	1						
CO2	3	3	3	1	1	1						1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5	0.3	0.3						0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand and solve telecommunication design issues using cellular and trunking theory.

CO2: Interpret the functions of the building blocks of cellular network architecture.

CO3: Perform practical link budget analysis for next generation cellular networks.

CO4: Analyze the effect of multipath channels and suggest a suitable model for indoor or outdoor applications.

CO5: Demonstrate the implications of multipath parameters in mobile communication.

CO6: Differentiate the digital modulation schemes available and select appropriate method to improve the performance of wireless communication.

SATELLITE COMMUNICATION

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Satellite Communication	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 7^{th}

THEORY

Learning objectives: After learning this course student will

1) Understand the basics of satellite orbits
2) Understand the satellite segment and earth segment
3) Analyze the various methods of satellite access

Prerequisite: Electronics Communication, Digital Communication.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	4	7%
Module-II: Orbital Mechanics	8	17%
Module-III: Satellite sub-systems	10	21%
Module-IV: Typical Phenomena in Satellite Communication	10	21%
Module-V: Modulation and Multiple Access Schemes	8	17%
Module-VI: Satellite Applications and Future Trends	8	17%

SYLLABUS OUTLINE:

Module I: Introduction: [4L]

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

Module II: Orbital Mechanics: [8L]

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

Module III: Satellite sub-systems: [10L]

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

Module IV: Typical Phenomena in Satellite Communication: [10L]

Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift. Satellite link budget Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Module V: Modulation and Multiple Access Schemes: [8L]

Analog and Digital Modulation Techniques in Satellite Communication, Frequency Modulation (FM), Amplitude Modulation (AM), Phase Modulation (PM), Quadrature Amplitude Modulation (QAM); Multiple Access Techniques: FDMA, TDMA, CDMA; Spread Spectrum Techniques and their Applications in Satellite Communication, Overview of OFDM (Orthogonal Frequency-Division Multiplexing) for Satellites.

Module VI: Satellite Applications and Future Trends: [8L]

Satellite Communication for TV Broadcasting (Direct-to-Home), VSAT (Very Small Aperture Terminals) Networks, GPS (Global Positioning System) and Navigation Satellites, Satellite Communication for Mobile Systems, Remote Sensing Satellites, Weather Monitoring Satellites, Military Applications; Satellite Internet Services, High Throughput Satellites (HTS); Future Trends: Software-Defined Satellites, CubeSats, 5G and Satellites, Quantum Satellites

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
2) Gérard Maral, Michel Bousquet, Zhili Sun, ”Satellite Communications Systems: Systems, Techniques and Technology”, Wiley, 6th Edition, 2020.
3) Maini Anil K., Agrawal Varsha, “Satellite Technology: Principles and Applications”, Wiley, 3rd

Edition, 2019.
4) Michael Olorunfunmi Kolawole, ”Fundamentals of Satellite Communications”, CRC Press, 2nd Edition, 2020.

Reference Books:

1) Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009 3.Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009.
2) “Satellite Communications Systems: Systems, Techniques and Technology” by Gerard Maral and Michel Bousquet
3) Bruce R. Elbert, “Introduction to Satellite Communication”, Artech House, 4th Edition, 2021.
4) N.A. Krivocheev, J.C. De Vries, A.V. Sadovnikov, “Satellite Communications: Principles and Applications”, Springer, 2nd Edition, 2021.
5) Hector Fenech, Roberto Sabatini, Mohammad S. Obaidat, “High-Throughput Satellites: Design, Systems, and Applications”, John Wiley & Sons, 1st Edition, 2020.
6) Geoff Varrall, “5G and Satellite Spectrum, Standards and Scale”, Artech House, 1st Edition, 2020.
7) Yang Yang, Wei Xiang, Shanzhi Chen, Hsiao-Hwa Chen, “Next Generation CubeSat-Based Internet of Things”, Springer, 1st Edition, 2020.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1		1						
CO2	3	3	3	1		1						1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5		0.3						0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand principle, working and operation of various sub systems of satellite as well as the earth station.

CO2: Apply various communication techniques for satellite applications

CO3: Analyze and design satellite communication link

CO4: Learn advanced techniques and regulatory aspects of satellite communication

CO5: Understand role of satellite in various applications

CO6: Describe the satellites used for applications in remote sensing, weather forecasting and navigation.

SEMESTER-VIII

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Project-II / Conversational Systems		Project	4	0	0	0	8
2	Project-II / Social Media Analytics		Project	4	0	0	0	8
3	NM Elective-V: Fiber Optic Communication / Sensors and Actuators		NM	4	3	1	0	0
Total Credit=12								

SOCIAL MEDIA ANALYTICS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P-S
NAME: Social Media Analytics	**COURSE CREDIT:** 04[0-0-0-8]
DEPARTMENT: Computer Science	**CATEGORY:** Project
CODE: XXXXXX	**SEMESTER:** 8^{th}

THEORY

Learning objectives:

1) To introduce the various tools for Text Mining and carry out Pattern Discovery, Predictive Modelling.
2) To Explore the use of social network analysis to understand the growing connectivity and complexity in the world around us on different scales
3) To Perform social media analytics to identify important social actors, subgroups and network properties in social media sites.

Prerequisite: Basic knowledge of Artificial Intelligence.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction to Text Mining	4	8%
Module-II: Text Mining Essentials	8	17%
Module-III: Web Mining	10	21%
Module-IV: Web Analytics Essentials	10	21%
Module-V: Social Media Networks	8	16%
Module-VI: Social Media Analytics	8	17%

SYLLABUS OUTLINE:

Module I: Introduction to Text Mining: [4L]

Introduction to Text Mining - Text Representation- Core text mining operations - Text mining applications

Module II: Text Mining Essentials: [6L]

Text mining Preprocessing techniques - Text Clustering, Text Classification, Topic Modelling, Probabilistic models for information extraction

Module III: Web Mining: [10L]

Web Analytics - Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval

Module IV: Web Analytics Essentials: [10L]

Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models

Module V: Social Media Networks: [8L]

Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization.

Module VI: Social Media Analytics: [8L]

Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis. Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Bing Liu, Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data, Springer, Second Edition, 2011.
2) Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, Social Media Mining-An Introduction, Cambridge University Press, 2014.

Reference Books:

1) Bing Liu, Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, Cambridge University Press, Second Edition, 2020.
2) Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, First Edition, 2009.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								
CO2	3	3	3	2								1
CO3	3	3	3	2								
CO4	3	3	3	2								
CO5	3	3	3	2								
CO6	3	3	3	2								
Avg.	3	3	3	2.16								0.16

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Interpret the contribution of text mining to generate new knowledge from natural language text

CO2: Extract useful information from the textual data using various classifiers and Predictors

CO3: Identify the various components of a web that can be used for mining process

CO4: Analyse social media data using appropriate web mining techniques

CO5: Discover interesting patterns from Social Media Networks using linear methods and models

CO6: Provide solutions to the emerging problems of social media analytics with sentiment analysis and opinion mining

FIBRE OPTIC COMMUNICATION

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Fibre Optic Communication	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 8^{th}

THEORY

Learning objectives:

1) To realize the significance of optical fiber communications.
2) To understand the construction and characteristics of optical fiber cable.
3) To develop the knowledge of optical signal sources and power launching.

Prerequisite: The students should have Computer Organization basics.

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	6	12%
Module-II: Different types of optical fibres	6	12%
Module-III: Fabrication	8	17%
Module-IV: Optical sources	8	17%
Module-V: Optical link design	10	21%
Module-VI: Optical amplifiers	10	21%

SYLLABUS OUTLINE:

Module I: Introduction: [6L]

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model

Module II: Different types of optical fibres: [6L]

Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation.

Module III: Fabrication: [8L]

Fabrication of fibers and measurement techniques like OTDR.

Module IV: Optical sources: [8L]

LEDs and Lasers, Photo-detectors-pin-diodes, APDs, detector responsivity, noise, optical receivers.

Module V: Optical link design: [10L]

BER calculation, quantum limit, power penalties, Optical switches -coupled mode analysis of directional couplers, electro-optic switches.

Module VI: Optical amplifiers: [10L]

EDFA, Raman amplifier, WDM and DWDM systems. Principles of WDM networks. Nonlinear effects in Fibre optic links. Concept of self-phase modulation, group velocity dispersion and solution-based communication.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2) T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.

Reference Books:

1) Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
2) “Fiber-Optic Communication Systems” by Govind P. Agrawal
3) “Fiber Optic Communications” by Joseph C. Palais
4) “Optical Fiber Communications: Principles and Practice” by John M. Senior
5) “Introduction to Fiber-Optic Communications” by Rongqing Hui
6) “Fiber Optic Communications: Fundamentals and Applications” by Shiva Kumar and M. Jamal Deen

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1		1						
CO2	3	3	3	1		1						1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5		0.3						0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Understand the principles fiber-optic communication, the components and the bandwidth advantages.

CO2: Understand the properties of the optical fibers and optical components.

CO3: Understand operation of lasers, LEDs, and detectors

CO4: Analyse system performance of optical communication systems

CO5: Design optical networks and understand non-linear effects in optical fibers.

CO6: Compare various optical detectors and choose suitable one for different applications.

SENSORS AND ACTUATORS

COURSE INFORMATION:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Sensors and Actuators	**COURSE CREDIT:** 04[3-1-0]
DEPARTMENT: Computer Science	**CATEGORY:** NM
CODE: XXXXXX	**SEMESTER:** 8^{th}

THEORY

Learning objectives:

1) Learn the characterization of sensors.
2) Known the working of Electromechanical, Thermal, Magnetic and radiation sensors
3) Understand the concepts of Electro analytic and smart sensors
4) Able to use sensors in different applications

Prerequisite: Basic electronics, Measurements and Instruments

Course content/ Syllabus table:

Module No.	No. of lecture / Contact hour	Weightage (%)
Module-I: Introduction	8	16%
Module-II: Motion, Proximity, and Ranging Sensors	10	21%
Module-III: Force, Magnetic and Heading Sensors	10	21%
Module-IV: Optical, Pressure and Temperature Sensors	12	25%
Module-V: Actuators	8	17%

SYLLABUS OUTLINE:

Module I: Introduction: [8L]

Basics of Measurement– Classification of errors– Error analysis– Static and dynamic characteristics of transducers– Performance measures of sensors – Classification of sensors– Sensor calibration techniques– Sensor Output Signal Types.

Module II: Motion, Proximity, and Ranging Sensors: [10L]

Motion Sensors– Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT– RVDT– Synchro– Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors– RF beacons, Ultrasonic

Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

Module III: Force, Magnetic and Heading Sensors: [10L]

Strain Gage, Load Cell, Magnetic Sensors– types, principle, requirement, and advantages: Magneto resistive– Hall Effect– Current sensor Heading Sensors– Compass, Gyroscope, Inclinometers.

Module IV: Optical, Pressure and Temperature Sensors: [12L]

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

Module V: Actuators: [8L]

Pneumatic and Hydraulic Actuation Systems, Valves, Rotary actuators, Mechanical Actuation Systems Electrical Actuation Systems.

- ***Pedagogy for Course Delivery:*** Hybrid Mode (Offline Class/ Presentation/ Video/ MOOC)
- ***Continuous Assessment:*** Quiz/ Assessment/ Presentation/ Problem solving etc.

Text & Reference books:

Text Books:

1) Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009
2) Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

Reference Books:

1) C. Sujatha, Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1		1						
CO2	3	3	3	1		1						1
CO3	3	3	3	1								1
CO4												1
CO5												1
CO6												1
Avg.	1.5	1.33	1.16	0.5		0.3						0.8

Highly Correlated: **3**
Moderately Correlated: **2**
Slightly Correlated: **1**

Course Learning Outcome: (CO)

CO1: Explain fundamental physical and technical base of sensors and actuators.

CO2: Describe basic laws and phenomena on which operation of sensor transformation of energy is based.

CO3: Analyses various premises, approaches, procedures and results related to sensors and actuators.

CO4: Create analytical design and development solutions for sensors and actuators.

CO5: Design and implement electro-pneumatic/ hydraulic solutions for automated systems.

CO6: Design and implement electro-pneumatic/ hydraulic solutions for automated systems.