Sister Nivedita University

DG 1/2 New Town, Kolkata – 700156

www.snuniv.ac.in

OBE-Related Academic Curriculum

School of Engineering

Department of Computer Science

Bachelor of Technology (B. Tech)

Computer Science and Engineering

(Data Science)

Regulations (R24)

A Satyam Roychowdhury initiative

SNU
SISTER NIVEDITA UNIVERSITY

School of Engineering

Department of Computer Science
Computer Science and Engineering

Vision

To be a centre of excellence in computing, AI, and data-driven technologies, recognized for impactful research and innovation, while producing globally competent, ethical professionals and entrepreneurs who lead digital transformation across industries, and advancing interdisciplinary solutions that serve societal needs and support sustainable national and regional development.

Mission

1. Deliver an outcome-based curriculum that blends strong computing fundamentals with emerging technologies through labs, projects, and real-world problem solving.
2. Foster a culture of research, innovation, and industry collaboration, entrepreneurship support, and modern infrastructure.
3. Nurture professionalism, ethics, inclusivity, effective communication, leadership, and lifelong learning to prepare graduates for responsible societal impact.

A Satyam Roychowdhury initiative

SNU
SISTER NIVEDITA UNIVERSITY

School of Engineering

Department of Computer Science
Bachelor of Technology (B. Tech)
Computer Science and Engineering (Data Science)

Program Educational Objectives (PEO)

PEO 1:

Professional Competence and Technical Expertise: Graduates of the B. Tech in CSE (Data Science) will demonstrate strong technical competence and a deep understanding of data science principles, techniques, and tools. They will be equipped to analyze complex data, develop predictive models, and apply data-driven solutions to address real-world problems across various industries.

PEO 2:

Lifelong Learning and Professional Development: Graduates will commit to lifelong learning and continuous professional development to stay current with evolving data science technologies, methodologies, and industry best practices. They will actively engage in self-directed learning, research, and professional networking to enhance their skills and adaptability, ensuring sustained growth and relevance in the ever-changing field of data science.

PEO 3:

Leadership and Innovation: Graduates will exhibit leadership qualities and innovative thinking by initiating and leading projects that leverage data science techniques to create impactful solutions. They will demonstrate the ability to think critically, solve complex problems creatively, and adapt to dynamic technological environments, driving innovation and contributing to the success and growth of their organizations and communities.

PEO 4:

Ethical and Social Responsibility: Graduates will understand and uphold the ethical, legal, and societal implications of data science practices, demonstrating a commitment to responsible and sustainable development. They will consider issues such as data privacy, security, and the broader impact of their work on society, ensuring their professional endeavors adhere to the highest ethical standards.

Program Specific Objectives (PSO)

PSO 1:

Proficiency in Data Science Techniques and Tools: Graduates will demonstrate proficiency in core data science techniques and tools, including data collection, data cleaning, data visualization, statistical analysis, and machine learning. They will be able to apply these techniques to analyze large datasets and derive meaningful insights.

PSO 2:

Design and Implementation of Data-Driven Solutions: Graduates will be capable of designing, developing, and implementing data-driven solutions for complex problems. They will demonstrate the ability to build predictive models, perform data analytics, and utilize artificial intelligence and machine learning algorithms to support decision-making processes.

PSO 3:

Innovation and Problem-Solving in Data Science: Graduates will exhibit strong problem-solving skills and innovative thinking in the data science domain. They will be able to analyze complex real-world challenges, propose creative solutions, and apply emerging data science technologies to develop impactful and sustainable advancements, addressing the needs of industries and society.

Program Outcomes (POs): Graduate Attributes and Professional Competencies

Version 4.0 (GAPC V4.0)

Source: **https://www.nbaind.org/files/2-SAR-UG-EG-T2-14-1-2025_Format_20250115122255.pdf**

Program Outcomes (POs)

PO1: Engineering Knowledge

Apply knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization (as specified in WK1 to WK4) to develop solutions for complex engineering problems.

PO2: Problem Analysis

Identify, formulate, review research literature, and analyze complex engineering problems to reach substantiated conclusions with due consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions

Design creative solutions for complex engineering problems and design or develop systems, components, and processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon goals, cultural context, societal impact, and environmental sustainability. (WK5)

PO4: Conduct Investigations of Complex Problems

Conduct investigations of complex engineering problems using research-based knowledge, including experimental design, modelling, analysis, and interpretation of data, to provide valid conclusions. (WK8)

PO5: Engineering Tool Usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools—including prediction and modelling—recognizing their limitations, to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and the World

Analyze and evaluate societal and environmental aspects while solving complex engineering problems, assessing their impact on sustainability in terms of economy, health, safety, legal frameworks, culture, and environment. (WK1, WK5, and WK7)

PO7: Ethics

Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion, adhering to both national and international laws. (WK9)

PO8: Individual and Collaborative Team Work

Function effectively as an individual and as a member or leader in diverse and multidisciplinary teams.

PO9: Communication

Communicate effectively and inclusively within the engineering community and with society at large. Be able to comprehend and write effective reports, prepare design documentation, and make clear, culturally sensitive presentations considering linguistic and learning diversity.

PO10: Project Management and Finance

Apply knowledge and understanding of engineering management principles and economic decision-making to one's own work, functioning as a member and leader in a team, and to manage projects in multidisciplinary environments.

PO11: Life-Long Learning

Recognize the need for, and possess the preparation and ability for:

i) Independent and lifelong learning
ii) Adaptability to new and emerging technologies, and
iii) Critical thinking in the broadest context of technological change. (WK8)

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School of Engineering
Department of Computer Science & Engineering

SYLLABUS
FOR
BACHELOR OF TECHNOLOGY (B. TECH) IN DATA SCIENCE

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	0	1	4	2	0	2	0	25
3	16	4	0	0	2	4	2	0	0	0	28
4	18	0	0	0	1	0	2	3	0	0	24
5	10	4	0	4	1	4	0	3	0	0	26
6	5	8	0	4	3	0	0	3	2	0	25
7	0	0	4	4	2	0	0	0	0	4	14
8	0	0	8	4	0	0	0	0	0	0	12
Credits/Course	**76**	**16**	**12**	**20**	**12**	**12**	**8**	**9**	**6**	**4**	**175**

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 (PO)

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

PO8. Individual and Team Work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO9. 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.

PO10. 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.

PO11. 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.

Program Specific Objectives (PSO)

PSO 1:

Proficiency in Data Science Techniques and Tools: Graduates will demonstrate proficiency in core data science techniques and tools, including data collection, data cleaning, data visualization, statistical analysis, and machine learning. They will be able to apply these techniques to analyze large datasets and derive meaningful insights.

PSO 2:

Design and Implementation of Data-Driven Solutions: Graduates will be capable of designing, developing, and implementing data-driven solutions for complex problems. They will demonstrate the ability to build predictive models, perform data analytics, and utilize artificial intelligence and machine learning algorithms to support decision-making processes.

PSO 3:

Innovation and Problem-Solving in Data Science: Graduates will exhibit strong problem-solving skills and innovative thinking in the data science domain. They will be able to analyze complex real-world challenges, propose creative solutions, and apply emerging data science technologies to develop impactful and sustainable advancements, addressing the needs of industries and society.

FIRST YEAR

SEMESTER-I

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Discrete Mathematics		MC	3	2	1	0	0
2	Fundamentals of Computer Science and Problem Solving		MC	3	2	1	0	0
3	Probability and Statistics		MC	4	3	1	0	0
4	NM Elective I: Digital Electronics		NM	3	2	1	0	0
5	Soft-Skill Development-I		NV	1	0	0	0	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-I		NV	1	0	0	0	2
7	Communicative English-I		AEC	2	2	0	0	0
8	Environmental Science-I		VAC	2	2	0	0	0
Practical								
9	Fundamentals of Computer Science and Problem Solving Lab		MC	1	0	0	2	0
10	Digital Electronics Lab		NM	1	0	0	2	0
				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	S
1	Data Structures		MC	4	3	1	0	0
2	Computer Architecture		MC	3	2	1	0	0
3	Formal Language and Automata Theory		MC	3	2	1	0	0
4	Object Oriented Programming with Java		MC	3	2	1	0	0
5	Numerical Methods and Programming/ Optimization Technique		ME	3	2	1	0	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-II		NV	1	0	0	0	2
7	Soft-Skill Development-III		NV	1	1	0	0	0
8	MDC II: Biology for Engineers		MDC	4	2	0	0	0
9	Foreign Language-I		AEC	2	2	0	0	0
Practical								
10	Data Structures Lab		MC	1	0	0	2	0
11	Computer Architecture Lab		MC	1	0	0	2	0
12	Object Oriented Programming with Java Lab		MC	1	0	0	2	0
13	Numerical Methods and Programming Lab/ Optimization Technique Lab		ME	1	0	0	2	0
				Total Credit=28				

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: Probability Distributions		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	4	3	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=26								

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	Exploratory Data Analysis / Social Media Analytics		ME	3	2	1	0	0
3	Business Intelligence/ Natural Language Processing/ Human Computer Interface		ME	4	3	1	0	0
4	NM Elective-III: Sampling Distributions and Statistical Inference		NM	4	3	1	0	0
5	Soft-Skill Development-VI		NV	1	1	0	0	0
6	Scientific and Technical Writing		NV	2	1	0	0	2
7	SEC3: Entrepreneurship Skill Development/ Salesforce CRM and Cloud Applications		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	Exploratory Data Analysis Lab/ Social Media Analytics 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 / Predictive Analytics		Project	4	0	0	0	8
3	Summer Internship		INT	4	0	0	0	8
4	NM Elective-IV: Regression and ANOVA		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 / Healthcare Data Analytics		Project	4	0	0	0	8
2	Project-II / Enterprise Systems		Project	4	0	0	0	8
3	NM Elective-V: Time series and Multivariate Analysis		NM	4	3	1	0	0
Total Credit = 12								

FIRST YEAR

SEMESTER-I

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

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO):

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

CO1: Explain the fundamental properties to solve problems in algebraic structures with clarity.

CO2: Solve logical structures and standard forms accurately.

CO3: Examine analytical techniques to solve mathematical or computational problems.

CO4: Design efficient systems using logical and systematic methods.

CO5: Evaluate complex structures to determine optimal solutions.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	–	–	–	–	–	–	–	1	3	2	1
CO2	3	3	2	1	1	–	–	–	–	–	–	3	2	1
CO3	2	3	2	2	1	–	–	–	–	–	–	3	2	2
CO4	2	2	3	2	2	1	1	1	2	2	1	2	3	3
CO5	2	3	3	2	2	1	1	1	1	1	1	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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)

Teaching–Learning Methodology:

- ***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 edition, 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

Course Outcome (CO): .....

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

CO1: Explain the basic concepts of computer systems, hardware, software, and operating environments.

CO2: Apply fundamental programming constructs such as data types, operators, control structures, and functions to solve computational problems.

CO3: Analyze real-world problems and design appropriate algorithms and flowcharts for their solution.

CO4: Develop and debug simple programs using structured programming approaches in C.

CO5: Demonstrate problem-solving skills through modular programming and testing techniques for computational efficiency and correctness.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	2	1	-
CO2	3	3	2	-	3	-	-	-	-	-	1	2	2	1
CO3	3	3	2	2	2	1	-	-	-	-	2	3	3	2
CO4	3	2	2	3	3	-	-	1	1	-	2	2	3	2
CO5	3	3	3	2	3	1	-	2	2	2	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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. Sheppard'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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1: Discuss basic statistical concepts, data types and its modes of representations.

CO2: Illustrate the concepts of univariate data analysis using measures of central tendency, dispersion, skewness and kurtosis.

CO3: Examine the nature of bivariate data analysis using the techniques of simple correlation, simple linear regression and rank correlation.

CO4: Judge the applicability of probability theory to solve real-life random experiments.

CO5: Formulate the methodologies of dealing with random variables and their probability distributions.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	1	1	1	1	2	2	2	2	2
CO2	3	3	3	3	3	3	2	2	2	2	3	3	3	3
CO3	3	3	3	3	3	3	2	2	2	2	3	3	3	3
CO4	3	3	3	3	3	2	1	2	1	3	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	2	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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

Teaching–Learning Methodology: .....

- ***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

Course Outcome (CO): .....

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

CO1: Explain the principles of number systems, Boolean algebra, and the characteristics of different logic families.

CO2: Implement simplified logic functions using Boolean theorems and Karnaugh maps.

CO3: Analyze the operation of combinational logic circuits, including multiplexers, decoders, and adders.

CO4: Differentiate the functional behavior of various flip-flops, registers, and counters.

CO5: Design sequential and combinational logic circuits to perform a specified task.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	1	1	1	-
CO2	3	2	2	1	1	-	-	-	-	-	1	2	2	-
CO3	3	3	1	2	-	-	-	-	-	-	1	2	3	-
CO4	3	3	1	2	-	-	-	-	-	-	1	2	3	1
CO5	3	3	3	2	2	-	-	-	-	-	2	3	3	2

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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: XXXXXX	**Semester:** 1^{st}

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	4	30%
Module-II: Spoken English Communication	4	30%
Module-III: Vocabulary	2	20%
Module-IV: Introduction to Written English	1	10%
Module-V: Prose	1	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

Teaching–Learning Methodology:

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

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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: XXXXXX	**Semester:** 1^{st}

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.

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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)

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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 Practicals:

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:** NM
Code: XXXXXX	**Semester:** 1^{st}

List of Practicals:

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}

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.

Teaching–Learning Methodology:

- ***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

Course Outcome (CO):

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

CO1: Identify different types and properties of matrices and determinants.

CO2: Solve systems of linear equations through matrix operations.

CO3: Explain the concepts of vector spaces, subspaces, basis, and dimension.

CO4: Analyze linear transformations and their representations using eigenvalues and eigenvectors.

CO5: Design simple applications of linear algebra concepts in areas such as image processing and machine learning.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	1	2	2	-
CO3	3	3	-	-	-	-	-	-	-	-	1	-	2	2
CO4	3	3	1	-	-	-	-	-	-	-	1	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology:

- ***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

Course Outcome (CO):

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

CO1: Explain fundamental concepts of arrays, strings, functions, pointers, structures, unions, enums, and file handling in C programming

CO2: Use array, string, and function in constructing modular programs for solving computational problems.

CO3: Examine recursive functions, pointer operations, and dynamic memory allocation to enhance program efficiency and correctness.

CO4: Select appropriate searching and sorting algorithms based on dataset characteristics to ensure efficiency.

CO5: Design a modular program that integrates structures and file handling to organize and maintain records.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	1	-	1	2	-	2	3	1	1
CO2	3	3	2	-	2	2	-	2	1	-	2	3	2	2
CO3	3	3	2	2	3	1	-	1	1	-	2	3	3	2
CO4	2	3	2	2	3	2	1	1	2	2	2	2	3	2
CO5	3	3	3	2	2	3	1	3	1	2	3	2	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology:

- ***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

Course Outcome (CO): .....

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

CO1: Understand the basic concept and working principles the computer organization.

CO2: Design the core subsystems of a central processing unit (CPU), including the arithmetic logic unit (ALU) and control unit.

CO3: Distinguish the interaction between the processor, memory and input/output subsystems.

CO4: Analyze execution mechanism, control mechanisms, and data flow between subsystems functionality of computer systems.

CO5: Design and Implement efficient computer subsystems like memory and input/output.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	1	3	2	1
CO2	3	3	3	2	2	-	-	-	-	1	1	2	3	2
CO3	2	2	2	1	2	-	-	-	-	-	1	2	3	1
CO4	3	3	2	2	2	1	-	-	-	-	1	2	1	3
CO5	3	2	3	2	3	1	-	1	1	2	2	1	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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: XXXXXX	**Semester:** 2^{nd}

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	4	30%
Module-II: Verbal Communication	4	30%
Module-III: Non-Verbal Communication	2	20%
Module-IV: Listening Skills	1	10%
Module-V: Prose	1	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

Teaching–Learning Methodology: .....

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

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

MDC I: ENGINEERING PHYSICS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: MDC I: Engineering Physics	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** MDC
Code: XXXXXX	**Semester:** 2^{nd}

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.

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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: XXXXXXXX	**Semester:** 2^{nd}

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

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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

Teaching–Learning Methodology:

- **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

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

ENVIRONMENTAL SCIENCE-II

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Environmental Science-II	**Course Credit:** 02[2-0-0]
Department: Computer Science	**Category:** VAC
Code: XXXXXX	**Semester:** 2^{nd}

Learning Objectives:

Prerequisite:

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Type module name		%
Module-II: Type module name		%
Module-III: Type module name		%
Module-IV: Type module name		%
Module-V: Type module name		%
Module-VI: Type module name		%

Syllabus Outline: .....

Module I: Module Name: [L]

Module II: Module Name: [L]

Module III: Module Name: [L]

Module IV: Module Name: [L]

Module V: Module Name: [L]

Module VI: Module Name: [L]

Teaching–Learning Methodology: .....

- ***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.
2.

Reference Books:

1.
2.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:.....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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 Practicals:

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 Practicals:

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 Practicals:

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	S
1	Data Structures		MC	4	3	1	0	0
2	Computer Architecture		MC	3	2	1	0	0
3	Formal Language and Automata Theory		MC	3	2	1	0	0
4	Object Oriented Programming with Java		MC	3	2	1	0	0
5	Numerical Methods and Programming/ Optimization Technique		ME	3	2	1	0	0
6	Anyone (Sports/Yoga/NCC/NSS) EAA-II		NV	1	0	0	0	2
7	Soft-Skill Development-III		NV	1	1	0	0	0
8	MDC II: Biology for Engineers		MDC	4	3	1	0	0
9	Foreign Language-I		AEC	2	2	0	0	0
Practical								
10	Data Structures Lab		MC	1	0	0	2	0
11	Computer Architecture Lab		MC	1	0	0	2	0
12	Object Oriented Programming with Java Lab		MC	1	0	0	2	0
13	Numerical Methods and Programming Lab/ Optimization Technique Lab		ME	1	0	0	2	0
				Total Credit=28				

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}

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).

Teaching–Learning Methodology: .....

- ***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

Course Outcome (CO): .....

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

CO1: Explain the fundamental concepts of algorithms and the time complexity of the algorithms.

CO2: Utilize linear and non-linear data structures with their standard operations in relevant applications.

CO3: Compare various sorting and searching techniques based on their underlying principles and time complexities.

CO4: Select suitable data structures for solving problems based on their application requirements and performance characteristics.

CO5: Design efficient solutions for real-world problems using appropriate data structures and algorithms.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	–	1	–	–	–	–	–	1	3	2	1
CO2	3	3	2	2	2	–	–	1	1	–	2	3	3	2
CO3	3	3	2	2	2	–	–	1	1	–	2	3	3	2
CO4	3	3	3	2	3	–	–	1	1	1	3	3	3	3
CO5	3	3	3	3	3	–	–	2	1	2	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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, transition 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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO):

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

CO1: Understand of formal language theory, foundational models of computation.

CO2: Analyze various computational models such as finite automata, grammars, and Turing machines to represent and solve computational problems.

CO3: Apply formal techniques to determine the regularity, context-freeness, or decidability of languages and problems.

CO4: Design the computational power and limitations of different automata and machine models with respect to language recognition and problem-solving capabilities.

CO5: Analyze computational problems based on complexity theory to differentiate between classes such as P, NP, NP-hard, and NP-complete.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	2	3	2	1
CO2	2	3	2	3	2	-	-	-	-	-	2	3	3	2
CO3	2	3	2	3	3	-	-	-	-	-	2	3	3	2
CO4	2	2	3	3	3	-	-	1	1	1	2	3	3	3
CO5	2	3	2	3	3	-	-	-	-	2	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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?.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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).

Teaching–Learning Methodology:

- ***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).

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

OPTIMIZATION TECHNIQUE

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Optimization Technique	**Course Credit:** 03[2-1-0]
Department: Computer Science	**Category:** ME
Code: XXXXXX	**Semester:** 3^{rd}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1: Recall the fundamental concepts, terminology, and types of Operations Research problems and mathematical formulations

CO2: Explain the principles of linear programming.

CO3: Solve transportation and assignment problems using various methods.

CO4: Analyze various queuing models in terms of performance.

CO5: Construct project networks techniques for estimation of project duration, identifying critical paths, and proposing time-cost trade-offs.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	2	3	2	–
CO2	3	3	2	2	3	-	-	-	-	-	2	3	3	2
CO3	3	3	2	2	3	-	-	1	-	2	2	3	3	2
CO4	3	3	2	3	3	2	-	-	-	-	3	3	3	3
CO5	2	3	3	3	3	2	-	2	2	3	3	2	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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: XXXXXX	**Semester:** 3^{rd}

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

Teaching–Learning Methodology:

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

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

MDC II: BIOLOGY FOR ENGINEERS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: MDC II: Biology for Engineers	**Course Credit:** 04[2-0-0]
Department: Computer Science	**Category:** MDC
Code: XXXXXX	**Semester:** 3^{rd}

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

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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 Practicals:

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 Practicals:

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 Practicals:

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 Practicals:

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 Practicals:

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}

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.

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1: Define fundamental concepts of Database Management Systems and explain various database models, architectures, and components of DBMS.

CO2: Implement Entity-Relationship (ER) modeling and relational schema concepts to design and represent databases using various techniques to identify and resolve data redundancy and anomalies.

CO3: Examine database design alternatives and indexing strategies to enhance performance and data retrieval efficiency.

CO4: Detect transaction management and concurrency control mechanisms ensuring serializability, recoverability, and consistency in database systems.

CO5: Construct databases and retrieve information using complex queries in optimal way.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	1	3	2	1
CO2	3	3	3	-	2	-	-	-	-	-	1	3	3	2
CO3	3	3	2	-	3	-	-	-	-	-	1	3	3	2
CO4	3	2	3	2	-	-	-	-	-	-	1	2	3	2
CO5	3	3	3	-	3	-	-	-	-	2	2	2	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO):

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

CO1: Define the fundamental concepts of Artificial Intelligence and various types of agents, environments, and problem-solving approaches.

CO2: Implement different types of search algorithms to solve AI problems.

CO3: Examine reasoning techniques using various approaches and several inference mechanisms used in AI systems.

CO4: Analyze various approaches and techniques of knowledge representation to model intelligent behavior in agents.

CO5: Construct intelligent systems using different techniques for real-world applications.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	2
CO2	2	3	3	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	-	2	2	-	-	-	-	-	2	3	3	3
CO4	2	-	2	-	3	1	-	-	1	-	2	3	2	3
CO5	2	-	3	-	3	-	-	2	-	2	2	1	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO): .....

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

CO1: Explain the basic concepts and operational principles of major algorithmic strategies.

CO2: Solve real-world computational problems using graph and string matching algorithms.

CO3: Distinguish complex computational problems into P, NP, NP-complete, and NP-hard categories based on the time complexity of algorithms.

CO4: Select efficient mathematical and geometric algorithms for solving applied computational problems.

CO5: Develop algorithmic solutions for NP-complete problems using reduction and approximation techniques.

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	–	1	–	–	–	–	–	1	3	2	1
CO2	3	3	3	2	2	–	–	1	1	–	1	2	3	2
CO3	3	3	2	2	1	–	–	–	–	–	2	3	2	3
CO4	3	3	3	2	3	–	–	1	–	1	2	2	3	3
CO5	3	3	3	3	2	–	–	2	1	2	3	2	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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: XXXXXXXXX	**Semester:** 4^{th}

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	7	59%
Module-II: Aptitude and Reasoning	3	25%
Module-III: Personality Development	1	8%
Module-IV: Professional grooming	1	8%

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

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SEC1: ADVANCED PROGRAMMING TECHNIQUES WITH R AND PYTHON

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: SEC1: Advanced Programming Techniques with R and Python	**Course Credit:** 03[1-0-4]
Department: Computer Science	**Category:** SEC
Code: XXXXXX	**Semester:** 4^{th}

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

Teaching–Learning Methodology: .....

- ***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)

Course Outcome (CO):

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

CO1: Explain the fundamental concepts of Python programming, and R programming including data types, operators, expressions, and control structures..

CO2: Implement Python programming constructs such as data structures, strings, regular expressions, and file handling to develop efficient computational solutions.

CO3: Outline data representation, manipulation, and visualization through appropriate data structures and graphical tools.

CO4: Construct interpret data using R by applying probability distributions, hypothesis testing, and related statistical methods on real-world datasets.

CO5: Apprise linear regression models in R and Python, interpret model outputs, and assess relationships between variables to support data-driven decision-making.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	3	-	-	1	-	2	3	2	3
CO2	3	3	2	2	2	3	-	-	1	-	2	3	3	3
CO3	3	2	3	2	2	3	-	-	-	-	3	3	3	3
CO4	3	3	2	3	3	3	1	1	1	-	3	1	3	3
CO5	3	3	3	3	3	3	1	2	1	-	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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 Practicals:

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 Practicals:

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 Practicals:

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: Probability Distributions		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	4	3	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=26								

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}

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.

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

PROBABILITY DISTRIBUTIONS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Probability Distributions	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** NM
Code: XXXXXX	**Semester:** 5^{th}

Learning Objectives:

1. To help students in forming the concepts of different Probability Inequalities and Generating Functions.
2. To help students in building knowledge of different discrete probability distributions along with their applications.
3. To help students in building knowledge of different continuous probability distributions along with their applications.
4. To help students in forming the concepts of Bivariate Generating Functions, Trinomial and Bivariate Normal distributions along with their applications.

Prerequisite: Basic knowledge about probability and random variable of one dimensional

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Probability Inequalities and Generating Functions	8	17%
Module-II: Standard discrete probability distributions	12	25%
Module-III: Standard continuous probability distributions	12	25%
Module-IV: Two dimensional Random Variables and Bivariate Normal distribution	16	33%

Syllabus Outline: .....

Module I: Probability Inequalities and Generating Functions: [8L]

Probability inequalities (Markov's and Chebychev's). Generating Functions, Probability Generating

Function (P.G.F.), Moment Generating Function (M.G.F.), Uniqueness and inversion theorems (without proof) along with applications.

Module II: Standard discrete probability distributions: [12L]
Discrete Uniform, Bernoulli, Binomial, Hypergeometric, Poisson, Geometric, Negative Binomial. Limiting/approximation cases. Truncated distributions.

Module III: Standard continuous probability distributions: [12L]
Rectangular, Exponential,Gamma, Beta, Normal, Lognormal, Cauchy along with their properties. Truncated distributions.

Module IV: Two dimensional Random Variables and Bivariate Normal distribution: [16L]
Bivariate Random Variables and its properties, joint, marginal and conditional distributions, properties of joint Cumulative Distribution Function, independence of Random Variables, theorems on sum and product of expectations of Random Variables, conditional moments, Correlation and Regression. Bivariate Probability Generating Function (P.G.F.) and Bivariate Moment Generating Function (M.G.F.). Bivariate Normal distribution (BVN): p.d.f. of BVN, properties of BVN,marginal and conditional p.d.f. of BVN

Teaching–Learning Methodology: .....

- ***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.

Reference Books:

1. Gun A.M. and Roy D. (2006): Problems In Probability Theory, 2nd Edition, World Press.
2. Ross S. (2002): A First Course in Probability, Prentice Hall.
3. Feller W. (1968): An Introduction to Probability Theory & its Applications, John Wiley.
4. Uspensky J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.

Course Outcome (CO): .....

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

CO1: Explain the fundamental concepts of probability inequalities and generating functions, highlighting their theoretical importance in probability theory.

CO2: Apply appropriate discrete and continuous probability distributions to solve real-life statistical problems and derive relevant measures.

CO3: Analyze relationships among random variables using joint, marginal, and conditional distributions, and evaluate dependence through correlation and regression measures.

CO4: Evaluate the suitability and limitations of various probability models, inequalities, and distributional assumptions in theoretical and applied contexts.

CO5: Construct probabilistic models using generating functions and bivariate distributions to explore properties, relationships, and applications of random variables.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	–	–	–	1	3	2	1
CO2	3	3	2	2	3	1	–	–	–	1	2	3	3	2
CO3	3	3	2	3	3	2	–	–	–	1	2	3	3	3
CO4	2	3	2	3	3	3	2	–	1	1	2	2	3	3
CO5	3	3	3	3	3	2	1	2	2	2	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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

Teaching–Learning Methodology:

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SEC2: PROGRAMMING WITH ADVANCED JAVA

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: SEC2: Programming with Advanced Java	**Course Credit:** 03[2-1-0]
Department: Computer Science	**Category:** SEC
Code: XXXXXX	**Semester:** 5^{th}

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.

Teaching–Learning Methodology: .....

- ***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

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

MDC III: DESIGN THINKING

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: MDC III: Design Thinking	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** MDC
Code: XXXXXX	**Semester:** 5^{th}

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:

Syllabus Outline: .....

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

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

MDC III: INDUSTRIAL PSYCHOLOGY

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: MDC III: Industrial Psychology	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** MDC
Code: XXXXXX	**Semester:** 5^{th}

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

Teaching–Learning Methodology:

- ***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

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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 Practicals:

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 Practicals:

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 Practicals:

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 Practicals:

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	Exploratory Data Analysis / Social Media Analytics		ME	3	2	1	0	0
3	Business Intelligence/ Natural Language Processing/ Human Computer Interface		ME	4	3	1	0	0
4	NM Elective-III: Sampling Distributions and Statistical Inference		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/ Salesforce CRM and Cloud Applications		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	Exploratory Data Analysis Lab/ Social Media Analytics 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}

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 Collaboration

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

EXPLORATORY DATA ANALYSIS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Exploratory Data Analysis	**Course Credit:** 03[2-1-0]
Department: Computer Science	**Category:** ME
Code: XXXXXX	**Semester:** 6^{th}

Learning Objectives:

This course imparts basic skills for collection & analysis of statistical data. Students should gain in-depth knowledge of finding patterns, spot anomalies, test hypotheses, and check assumptions through summary statistics and visualizations in presented data. To gain knowledge in statistical and high-level mathematical computing.To gain ability invarious libraries and packages needed to perform data analysis and data visualization.

Prerequisite:

Basic knowledge of programming (Python), Basic statistics and probability concept

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Introduction	4	11%
Module-II: Data Collection, Data Wrangling, Preprocessing and Analysis	6	17%
Module-III: Probability Distribution	10	28%
Module-IV: Data Visualization	8	22%
Module-V: Hypothesis Testing	6	17%
Module-VI: Case Studies and Applications	2	5%

Syllabus Outline: .....

Module I: Introduction: [4L]

Definition and Importance of EDA, Describing Data, Tools for EDA (Python, R), Statistical Data

Module II: Data Collection, Data Wrangling, Preprocessing and Analysis: [6L]

Collection, Importing and Presentation of Data, Handling Missing Data,Data Preprocessing, Handling Outliers and Anomalies, Data transformation (scaling, encoding categorical variables), Correlation and Regression analysis

Module III: Probability Distribution: [10L]

Distribution Analysis (Normal, Skewness, Kurtosis), Measures of Central Tendencies, Measures of Dispersion, Descriptive Statistics: Mean, Median, Mode, Variance, Standard Deviation, Bayes' Theorem, Distributions: Binomial, Poisson, Exponential and Normal Distribution, Random Variables – Discrete and Continuous Probability Distribution Functions.

Module IV: Data Visualization: [8L]

Principles of Data Visualization, Types of Charts (Bar Charts, Histograms, Scatter Plots, Box Plots, etc.), Using Libraries: Matplotlib, Seaborn (Python) or ggplot2 (R), Detecting Patterns and Relationships, Discrete Variables, Dependency Relationships, Temporal Data, Spatial Data, Visualization techniques:Univariate (histograms, box plots), Bivariate (scatter plots, bar charts), Multivariate (pair plots, heatmaps), Handling Time Series Data

Module V: Hypothesis Testing: [6L]

Standard Error, Tests of Significance, T Test, F Test, Z Test and Chi-Square Test Along with Their Applications, Goodness of Fit, Testing of Hypotheses and Decision Making, Analysis of Variance (ANOVA)

Module VI: Case Studies and Applications: [2L]

1. Real-world datasets (e.g., financial, health, or social datasets)
2. Mini projects: Performing EDA on provided datasets

Teaching–Learning Methodology: .....

- ***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. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly Media, 2016.

2. Grolemund, Garrett, and Hadley Wickham. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. O'Reilly Media, 2016.

Reference Books:

1. McKinney, Wes. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. O'Reilly Media, 2017.
2. Cioara, Jeremy, et al. Python Data Science Essentials. Packt Publishing, 2015.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SOCIAL MEDIA ANALYTICS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Social Media Analytics	**Course Credit:** 03[2-1-0]
Department: Computer Science	**Category:** ME
Code: XXXXXX	**Semester:** 6^{th}

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	11%
Module-II: Text Mining Essentials	6	17%
Module-III: Web Mining	8	22%
Module-IV: Web Analytics Essentials	8	22%
Module-V: Social Media Networks	4	11%
Module-VI: Social Media Analytics	6	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: [8L]

Web Analytics - Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval

Module IV: Web Analytics Essentials: [8L]

Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models

Module V: Social Media Networks: [4L]

Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization.

Module VI: Social Media Analytics: [6L]

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

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

BUSINESS INTELLIGENCE

Course Information:

School: School of Engineering	**Course Type:** L-T-P-S
Name: Business Intelligence	**Course Credit:** 04[0-0-0-8]
Department: Computer Science	**Category:** Project
Code: XXXXXX	**Semester:** 7^{th}

Learning Objectives:

Prerequisite:

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Type module name		%
Module-II: Type module name		%
Module-III: Type module name		%
Module-IV: Type module name		%
Module-V: Type module name		%
Module-VI: Type module name		%

Syllabus Outline: .....

Module I: Module Name: [L]

Module II: Module Name: [L]

Module III: Module Name: [L]

Module IV: Module Name: [L]

Module V: Module Name: [L]

Module VI: Module Name: [L]

Teaching–Learning Methodology: .....

- ***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.
2.

Reference Books:

1.
2.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:.....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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 to NLP	6	12%
Module-II: Language Model & Text Representation	10	21%
Module-III: Morphology and Part of Speech Tagging	8	17%
Module-IV: Text Parsing	8	17%
Module-V: LLM	8	17%
Module-VI: Applications of NLP	8	16%

Syllabus Outline: .....

Module I: Introduction to NLP: [6L]

Introduction to NLP, Challenges of NLP, Phases of NLP, Text pre-processing, Regular Expression, Corpus.

Module II: Language Model & Text Representation: [10L]

Introduction,N-Gram probability estimation and perplexity,Bag-of-word:Tf-IDF,Count vector,Vector space Model, Latent semantic Analysis, Word embedding, Word2Vec, Glove, fastText, Sentence embedding Technique: Doc2Vec.

Module III: Morphology and Part of Speech Tagging: [8L]

Morphology, Part of Speech Tagging, Rule-Based Part of Speech Tagging, Markov Models - Hidden Markov Models, Viterbi algorithms, Maximum Entropy Models.

Module IV: Text Parsing: [8L]

Syntax Parsing, Grammar formalisms and treebanks, Parsing with Context Free Grammars, Top-down and Bottom-up parsing, Dependency Parsing.

Module V: LLM: [8L]

Encoder-Decoder Models, Beam Search, Self-Attention and Transformers, Pretraining, Encoder-only (BERT).

Module VI: Applications of NLP: [8L]

Information Extraction, Introduction to Named Entity Recognition and Relation Extraction, Question Answering, Text Summarization, Dialog System, Machine Translation.

Teaching–Learning Methodology:

- ***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. D. Jurafsky and J. Martin “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition draft
2. C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”,MIT Press, 1999

Reference Books:

1. J. Allen, “Natural Language Understanding”, 2nd edition, Benjamin/Cummings publishing company, 1995. 2. G. J. Kowalski and M.T. Maybury, “Information Storage and Retrieval systems”, Kluwer academic Publishers, 2000.

Course Outcome (CO):

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

CO1: Define the fundamental concepts of Artificial Intelligence and various types of agents, environments, and problem-solving approaches.

CO2: Implement different types of search algorithms to solve AI problems.

CO3: Examine reasoning techniques using various approaches and several inference mechanisms used in AI systems.

CO4: Analyze various approaches and techniques of knowledge representation to model intelligent behavior in agents.

CO5: Construct intelligent systems using different techniques for real-world applications.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	2
CO2	2	3	3	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	-	2	2	-	-	-	-	-	2	3	3	3
CO4	2	-	2	-	3	1	-	-	1	-	2	3	2	3
CO5	2	-	3	-	3	-	-	2	-	2	2	1	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SAMPLING DISTRIBUTIONS AND STATISTICAL INFERENCE

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Sampling Distributions and Statistical Inference	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** NM
Code: XXXXXX	**Semester:** 6^{th}

Learning Objectives:

1. To develop a basic idea about the concepts of sampling distributions of a statistic
2. To acquire the knowledge about the exact sampling distributions - χ^2, t and F
3. To develop the concepts regarding the process of using data analysis to infer properties of an underlying distribution of probability
4. To make the students learn how to make predictions and draw conclusions about a population based on limited information, which is often the case in real-world problems

Prerequisite: Probability and Probability Distributions

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Sampling Distributions	14	29%
Module-II: Point Estimation	14	29%
Module-III: Testing of Hypothesis	20	42%

Syllabus Outline: .....

Module I: Sampling Distributions: [14L]

Concepts of Population & Parameter, Random Sample & Statistic. Types of Population & Sampling. Sampling Distribution of a Statistic and its numerical applications. Sampling Fluctuations & Standard Error of a Statistic.Definitions & selected properties (statement only) of χ^2, t and F distributions and their applications. Sampling distributions of sample mean and variance for a univariate Normal population.

Definitions of Student's t and Fisher's t statistics.

Module II: Point Estimation: [14L]

Introduction to statistical inference. Concepts of point estimation, estimator and estimate, requirements of good estimator: unbiasedness and minimum variance, definition of Uniformly Minimum Variance Unbiased Estimator (UMVUE) and related applications. Methods of estimation - method of moments, method of least square and method of maximum likelihood estimation and selected problems associated to them.

Module III: Testing of Hypothesis: [20L]

Basic principles of hypothesis testing, null and alternative hypotheses, simple and composite hypotheses, critical region and acceptance region, definition of a test function, Type – I and Type – II errors and their probabilities, level of significance, size, power of a test. Power function of a test for composite alternatives and power curves, concept of P-value. Testing problems related to a single univariate Normal population and two independent Normal populations.

Teaching–Learning Methodology:

- ***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.: Fundamentals of Statistics, Vol. I, 8th Edition. World Press, Kolkata.
2. Gun A.M., Gupta M.K. and Dasgupta B.: An Outline of Statistical Theory, Vol. I, 4th Edition. The World Press Private Limited, Kolkata.

Reference Books:

1. Banerjee J. and Giri P.K.: Statistical Tools and Techniques, 7th Edition, Academic Publishers, Kolkata.
2. Rohatgi V. K. and Saleh A.K. Md. E.: An Introduction to Probability and Statistics. 2nd Edition. (Reprint) John Wiley and Sons, INC.

Course Outcome (CO):

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

CO1: Explain the fundamental concepts of population, sample, parameter, statistic, and various sampling distributions, emphasizing their roles in statistical inference.

CO2: Apply the properties of standard sampling distributions (χ^2, t, and F) to solve problems related to estimation and hypothesis testing.

CO3: Analyze the interrelationships among estimators obtained through different methods such as method of moments, least squares, and maximum likelihood estimation to identify efficient estimators.

CO4: Evaluate the appropriateness and performance of different statistical tests in terms of Type I and Type II errors, size, and power to support decision-making.

CO5: Design and formulate hypothesis testing frameworks and estimation procedures integrating sampling distributions and estimation theory to address practical inferential problems.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	–	–	–	–	2	3	2	2
CO2	3	3	2	2	3	1	–	–	–	1	2	3	3	2
CO3	3	3	2	3	3	1	–	–	–	1	3	3	3	3
CO4	2	3	3	3	3	2	2	–	1	1	3	2	3	3
CO5	3	3	3	3	3	2	2	2	2	2	3	3	3	3

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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

Teaching–Learning Methodology:

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

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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}

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.

Teaching–Learning Methodology: .....

- ***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

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SEC3: ENTREPRENEURSHIP SKILL DEVELOPMENT

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: SEC3: Entrepreneurship Skill Development	**Course Credit:** 03[2-1-0]
Department: Computer Science	**Category:** SEC
Code: XXXXXX	**Semester:** 6^{th}

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

Teaching–Learning Methodology:

- ***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

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SEC3: SALESFORCE CRM AND CLOUD APPLICATIONS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: SEC3: Salesforce CRM and Cloud Applications	**Course Credit:** 03[2-1-0]
Department: Computer Science	**Category:** SEC
Code: XXXXXX	**Semester:** 6^{th}

Learning Objectives:

1. To understand the concepts and importance of Customer Relationship Management (CRM).
2. To familiarize students with Salesforce as a leading cloud-based CRM solution.
3. To provide practical experience in customizing and extending CRM functionality.
4. To enable the development and integration of cloud-based business applications.
5. To introduce cloud architecture and the Salesforce platform for scalable enterprise solutions.

Prerequisite:

Basic knowledge of Web Technologies, Databases, and Software Engineering

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: CRM and Cloud Computing Basics	6	%
Module-II: Salesforce Platform Overview	7	%
Module-III: Declarative Development and Automation	8	%
Module-IV: Programmatic Development with Apex	9	%
Module-V: Lightning Web Components and App Development	8	%
Module-VI: Integration and Analytics	7	%

Syllabus Outline: .....

Module I: CRM and Cloud Computing Basics : [6L]

- Introduction to CRM: Evolution, types, and business relevance
- CRM components: Operational, Analytical, Collaborative
- Introduction to Cloud Computing: IaaS, PaaS, SaaS
- CRM as SaaS: Overview of market leaders

Module II: : Salesforce Platform Overview : [7L]

- Salesforce architecture and editions
- Navigating Salesforce Lightning interface
- Standard objects and their relationships (Account, Contacts, Leads)
- Custom objects and schema builder

Module III: Declarative Development and Automation: [8L]

- Customizing page layouts and record types
- Validation rules, workflow rules, and process builder
- Flows and approval processes
- Salesforce App Builder and Lightning App setup

Module IV: Programmatic Development with Apex: [9L]

- Apex syntax and data types
- SOQL and SOSL queries
- Writing triggers and classes
- Introduction to asynchronous Apex (future, batch, queueable)

Module V: Lightning Web Components and App Development: [8L]

- Component-driven development with LWC
- Events and data binding
- Creating reusable components
- Deployment using change sets and unmanaged packages

Module VI: Integration and Analytics: [7L]

- REST API and external integrations
- AppExchange and prebuilt integrations
- Reports, dashboards, and Einstein Analytics
- Final project: CRM application for a fictional business

Teaching–Learning Methodology: .....

- ***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. Paul Battisson, Learning Salesforce Development with Apex, Packt Publishing
2. Salesforce Official Documentation: https://developer.salesforce.com/docs

Reference Books:

1. Siddhesh Kabe, Salesforce Essentials for Administrators, Packt Publishing
2. Michael Wicherski, Advanced Apex Programming, Salesforce Press
3. Trailhead (Salesforce's Official Learning Platform): https://trailhead.salesforce.com

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

VAC: HUMAN VALUES AND ETHICS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: VAC: Human Values and Ethics	**Course Credit:** 02[2-0-0]
Department: Computer Science	**Category:** VAC
Code: XXXXXX	**Semester:** 6^{th}

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.

Teaching–Learning Methodology: .....

- ***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.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

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 Practicals:

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

EXPLORATORY DATA ANALYSIS LAB

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Exploratory Data Analysis Lab	**Course Credit:** 01[0-0-2]
Department: Computer Science	**Category:** ME
Code: XXXXXX	**Semester:** 6^{th}

List of Practicals:

1. Load a sample dataset and explore its basic properties.
   a) Setting up the environment:
   b) Python: Jupyter Notebook, Pandas, Matplotlib, Seaborn
   c) R: RStudio, dplyr, ggplot2
   d) Loading datasets (CSV, Excel, JSON)
2. Data Cleaning and Preprocessing
   a) Handling missing values (fillna(), dropna())
   b) Identifying and treating outliers using boxplots
   c) Encoding categorical variables
   d) Data transformation (scaling and normalization)

   Assignment: Clean a messy dataset by handling missing values and outliers.
3. Summary Statistics and Distributions
   a) Calculating descriptive statistics (mean(), median(), std())
   b) Frequency distribution and percentiles
   c) Visualizing distributions using histograms and density plots

   Assignment: Perform summary statistics on a given dataset and visualize distributions.
4. Univariate and Bivariate Visualization
   a) Univariate plots (bar chart, box plot, histogram)
   b) Bivariate plots (scatter plot, line plot)
   c) Using Seaborn or ggplot2 for advanced visualizations

   Assignment: Create univariate and bivariate visualizations for a dataset.
5. Correlation and Covariance Analysis
   a) Calculating correlation matrices
   b) Visualizing correlations using heatmaps
   c) Identifying highly correlated features

   Assignment: Explore the correlation between variables in a dataset and visualize the results.

6. Time Series Data Handling
   a) Loading and visualizing time series data
   b) Resampling and rolling statistics
   c) Identifying trends, seasonality, and noise

   Assignment: Perform EDA on a time series dataset and identify trends.
7. Multivariate Visualization
   a) Pair plots
   b) Heatmaps
   c) Cluster maps

   Assignment: Create a multivariate visualization to discover hidden patterns in the dataset.
8. Real-World Dataset Case Study
   a) EDA on a real-world dataset (e.g., COVID-19 data, financial data)
   b) Identifying insights and reporting findings
   c) Preparing a mini-report

   Assignment: Conduct a complete EDA on a dataset, from cleaning to reporting insights.
   (Collect, Import, Clean, Transform, Visualize, missing data and outliers)

SOCIAL MEDIA ANALYTICS LAB

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Social Media Analytics	**Course Credit:** 01[0-0-2]
Department: Computer Science	**Category:** MC
Code: XXXXXX	**Semester:** 4^{th}

List of Practicals:

1.
2.

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 / Predictive Analytics		Project	4	0	0	0	8
3	Summer Internship		INT	4	0	0	0	8
4	NM Elective-IV: Regression and ANOVA		NM	4	3	1	0	0
Total Credit = 14								

DIGITAL TRANSFORMATION FOR SUSTAINABLE SOCIETY

Course Information:

SCHOOL: School of Engineering	**COURSE TYPE:** L-T-P
NAME: Digital Transformation for Sustainable Society	**COURSE CREDIT:** 02[2-0-0]
DEPARTMENT: Computer Science	**CATEGORY:** NV
CODE: XXXXXX	**SEMESTER:** 7^{th}

Learning Objectives:

Prerequisite:

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Type module name		%
Module-II: Type module name		%
Module-III: Type module name		%
Module-IV: Type module name		%
Module-V: Type module name		%
Module-VI: Type module name		%

Syllabus Outline: .....

Module I: Module Name: [L]

Module II: Module Name: [L]

Module III: Module Name: [L]

Module IV: Module Name: [L]

Module V: Module Name: [L]

Module VI: Module Name: [L]

Teaching–Learning Methodology:

- ***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.
2.

Reference Books:

1.
2.

Course Outcome (CO):

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

PREDICTIVE ANALYTICS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Predictive Analytics	**Course Credit:** 04[0-0-0-8]
Department: Computer Science	**Category:** Project
Code: XXXXXX	**Semester:** 7^{th}

Learning Objectives:

1. Learn the fundamental principles of analytics for business and learn how to Visualize and explore data to better understand relationships among variables.
2. To understand the techniques of modeling and examine how predictive analytics can be used in decision making.
3. Apply predictive models to generate predictions for new data.

Prerequisite: Have the knowledge of Python.

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Introduction to Analytics	6	13%
Module-II: Data Pre-processing and Model Tuning	7	15%
Module-III: Predictive Modelling	7	15%
Module-IV: Comparison of Classification & Regression Models	14	29%
Module-V: Remedies for Severe Class Imbalance	7	14%
Module-VI: Time Series Analysis	7	14%

Syllabus Outline: .....

Module I: Introduction to Analytics: [6L]

Introduction to predictive analytics – Business analytics: types, applications- Models: predictive models – descriptive models – decision models - applications - analytical techniques.

Module II: Data Pre-processing and Model Tuning: [7L]

Data transformations: Individual predictors, Multiple predictors, Dealing with missing values, Removing. Adding, Binning Predictors, Computing, Model Tuning, Data Splitting, Resampling.

Module III: Predictive Modelling: [7L]

Propensity models, cluster models, collaborative filtering, applications and fundamental limitations. Statistical Modeling- Formal Definition, Model Comparison, Classification.

Module IV: Comparison of Classification & Regression Models: [14L]

Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule Based Models - Model Evaluation Techniques. Measuring Performance in Regression Models - Linear Regression and Its Cousins - NonLinear Regression Models - Regression Trees and Rule-Based Models Case Study: Compressive Strength of Concrete Mixtures.

Module V: Remedies for Severe Class Imbalance: [7L]

The Effect of Class Imbalance - Model Tuning - Alternate Cutoffs - Adjusting Prior Probabilities - Unequal Case Weights - Sampling Methods - Cost-Sensitive Training. Measuring Predictor Importance - Factors that can affect Model Performance

Module VI: Time Series Analysis: [7L]

Methods for time series analyses – Analysis: Motivation – Exploratory analysis – Prediction and forecasting – Classification – Regression analysis – Signal estimation – Segmentation. Models – Autoregressive model - Partial autocorrelation function.

Teaching–Learning Methodology: .....

- ***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. Kuhn, Max, and Kjell Johnson. Applied Predictive Modeling, 3rd Edition, Springer, 2019.
2. Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015.

Reference Books:

1. Anasse Bari, Mohamed Chaouchi, Tommy Jung, Predictive Analytics for dummies, 2nd edition Wiley, 2016.e
2. Daniel T.Larose and Chantal D.Larose, Data Mining and Predictive Analytics, 2nd edition Wiley, 2015.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

REGRESSION AND ANOVA

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Regression and ANOVA	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** NM
Code: XXXXXX	**Semester:** 7^{th}

Learning Objectives:

1. To provide students the fundamental knowledge of matrix algebra and inference.
2. To introduce the students with the basic theory of linear estimation.
3. To provide concept of simple and multiple regression models
4. To introduce ANOVA models, comparison between ANOVA and Regression models
5. Use some tools to test the model validity.

Prerequisite: Basic knowledge about probability, random variables, linear algebra.

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Gauss-Markov set-up	8	22%
Module-II: Regression Analysis and Regression Diagnostics	10	28%
Module-III: Analysis of Variance	12	33%
Module-IV: Analysis of Covariance	6	17%

Syllabus Outline: .....

Module I: Gauss-Markov set-up: [8L]

Introduction to linear models, classification, theory of linear estimation, estimability of linear parametric functions, method of least squares, Gauss-Markov theorem, estimation space and error space, estimation of error variance, fundamental theorems on least squares (statements only), linear hypothesis and its testing.

Module II: Regression Analysis and Regression Diagnostics: [10L]

Simple and Multiple regression analysis, estimation and hypothesis testing in case of simple and multiple

regression models, tests for parallelism and identity, linearity of simple regression. Model checking: prediction from a fitted model.

Module III: Analysis of Variance: [12L]

Definitions of fixed, random and mixed effect models, analysis of variancein one-way classified data for fixed effect models, analysis of variance in two-way classified data (with one observation per cell and more than one but equal observations per cell)for fixed effect models, analysis of variance in one-way classified data for random effect models.

Module IV: Analysis of Covariance : [6L]

Analysis of covariance(with one concomitant variable) in one-way classified data, analysis of covariance (with one concomitant variable) in two-way classified data.

Teaching–Learning Methodology:

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

Text & Reference Books:

1. Gun A.M., Gupta M.K. and Dasgupta B.: Fundamentals of Statistics, Vol. I, 8th Edition. World Press, Kolkata.
2. Gun A.M., Gupta M.K. and Dasgupta B.: Fundamentals of Statistics, Vol. II, 8th Edition, The World Press Private Limited, Kolkata.

Reference Books:

1. Scheffe H. (1959): The Analysis of Variance, John Wiley.
2. Rao C.R. (2009): Linear Statistical Inference and its Applications, 2nd Edition, John Wiley & Son, Inc.
3. Faraway J.J. (2014): Linear Models with R, 2nd Edition, CRC Press.
4. Gupta S.C. and Kapoor V.K. (1975): Fundamentals of Applied Statistics: A Modern Approach, S. Chand & Company.

Course Outcome (CO):

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

CO1: Describe the concepts of Gauss-Markov set-up.

CO2: Demonstrate the fundamental concepts of testing linear hypothesis.

CO3: Figure out the method of least squares in simple and multiple regression models.

CO4: Justify the knowledge of different tests in simple and multiple regression set-up.

CO5: Develop analysis of variance and analysis of covariance models to test the significance of several means.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	0	1	0	3	2	3	3	2
CO2	2	3	3	3	2	2	1	2	0	2	3	3	2	2
CO3	2	3	3	2	2	2	0	1	1	2	2	3	2	1
CO4	2	3	3	2	2	2	0	2	2	3	3	3	3	1
CO5	3	3	3	3	3	2	2	1	-	3	3	3	3	2

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

SEMESTER-VIII

Sl No	Course Title	Code	Category	Credit	Type			
					L	T	P	S
1	Project-II / Healthcare Data Analytics		Project	4	0	0	0	8
2	Project-II / Enterprise Systems		Project	4	0	0	0	8
3	NM Elective-V: Time series and Multivariate Analysis		NM	4	3	1	0	0
Total Credit = 12								

HEALTHCARE DATA ANALYTICS

Course Information:

School: School of Engineering	**Course Type:** L-T-P-S
Name: Healthcare Data Analytics	**Course Credit:** 04[0-0-0-8]
Department: Computer Science	**Category:** Project
Code: XXXXXX	**Semester:** 8^{th}

Learning Objectives:

1. Describe how data-based healthcare can help in improving outcomes for patient health.
2. To design data models that combine patient records from multiple sources to form a patient centric view of data.
3. To use data analytics to find health concerns and solutions to the problem faced by a patient.
4. To find meaningful patterns and trends in healthcare data to help the overall population.

Prerequisite: Basic knowledge of Artificial Intelligence.

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Introduction to Healthcare Data Analytics	4	8%
Module-II: Healthcare Foundations	6	12%
Module-III: Machine Learning Foundations for Healthcare	10	21%
Module-IV: Measuring Healthcare Quality	8	17%
Module-V: Making Predictive Models in Healthcare	8	17%
Module-VI: Healthcare Analytics Applications and Emerging Technologies	12	25%

Syllabus Outline: .....

Module I: Introduction to Healthcare Data Analytics: [4L]

Introduction – Need for Healthcare Analytics - Foundations of Healthcare Analytics – Examples of Healthcare Analytics.

Module II: Healthcare Foundations: [6L]

Healthcare delivery - Healthcare financing - Healthcare policy – Handling Patient data: the journey from patient to computer - Standardized clinical codesets - Breaking down healthcare analytics: population, medical task, data format, disease.

Module III: Machine Learning Foundations for Healthcare: [10L]

Model frameworks for medical decision making: Tree-like reasoning, Probabilistic reasoning and Bayes theorem, Criterion tables and the weighted sum approach, Pattern association and neural networks - Machine learning pipeline: Loading the data, Cleaning and preprocessing the data, Exploring and visualizing the data, selecting features, Training the model parameters, Evaluating model performance.

Module IV: Measuring Healthcare Quality: [8L]

Introduction to healthcare measures, Medicare value-based programs: The Hospital ValueBased Purchasing (HVBP) program, The Hospital Readmission Reduction (HRR) program, The Hospital-Acquired Conditions (HAC) program, The End-Stage Renal Disease (ESRD) quality incentive program, The Skilled Nursing Facility Value-Based Program (SNFVBP), The Home Health Value-Based Program (HHVBP), The Merit-Based Incentive Payment System (MIPS).

Module V: Making Predictive Models in Healthcare: [8L]

Introduction to Predictive Analytics – Obtaining and Importing the NHAMCS Dataset – Making the Response Variable - Splitting the Data into Train and Test Sets - Preprocessing the Predictor Variables – Building the Models – Using the Models to Make Predictions – Improving our Models.

Module VI: Healthcare Analytics Applications and Emerging Technologies: [12L]

Introduction - Descriptive Analytics Applications - Predictive Analytics Applications - Prescriptive Analytics Application. Healthcare analytics and the internet - Healthcare and the Internet of Things – Healthcare analytics and social media - Healthcare and deep learning - Obstacles, ethical issues, and limitations.

Teaching–Learning Methodology: .....

- ***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. Pradeep KumarMallick, Samarjeet Borah,“ Emerging Trends and Applications in Cognitive

Computing", 2019, IGI Global Publishers

Reference Books:

1. Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", 2020 Cambridge University Press, New York.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping: .....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

ENTERPRISE SYSTEMS

Course Information:

School: School of Engineering	**Course Type:** L-T-P-S
Name: Enterprise Systems	**Course Credit:** 04[0-0-0-8]
Department: Computer Science	**Category:** Project
Code: XXXXXX	**Semester:** 8^{th}

Learning Objectives:

Prerequisite:

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Type module name		%
Module-II: Type module name		%
Module-III: Type module name		%
Module-IV: Type module name		%
Module-V: Type module name		%
Module-VI: Type module name		%

Syllabus Outline: .....

Module I: Module Name: [L]

Module II: Module Name: [L]

Module III: Module Name: [L]

Module IV: Module Name: [L]

Module V: Module Name: [L]

Module VI: Module Name: [L]

Teaching–Learning Methodology: .....

- ***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.
2.

Reference Books:

1.
2.

Course Outcome (CO): .....

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

CO1:

CO2:

CO3:

CO4:

CO5:

CO-PO-PSO Mapping:.....

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*

TIME SERIES AND MULTIVARIATE ANALYSIS

Course Information:

School: School of Engineering	**Course Type:** L-T-P
Name: Time series and Multivariate Analysis	**Course Credit:** 04[3-1-0]
Department: Computer Science	**Category:** NM
Code: XXXXXX	**Semester:** 8^{th}

Learning Objectives:

1. To provide students the fundamental knowledge of different statistical methods of time series analysis along with their applications.
2. To implement the concepts of stochastic modelling and gain fundamental knowledge of special stationary processes.
3. To find patterns and correlations between several variables simultaneously.
4. To analyze complex datasets, allowing to gain deeper understanding of the data and how it relates to real-world scenarios.
5. To apply in Pattern Recognition and Dimension Reduction.

Prerequisite: Basic knowledge about probability, random variables, linear algebra.

Course Content/ Syllabus Table:

Module No.	No. of Lecture / Contact hour	Weightage (%)
Module-I: Introduction to time series and estimation of trend and seasonal components	14	29%
Module-II: Introduction to stochastic modelling and different stationary processes	10	21%
Module-III: Multivariate Probability Distribution and Multiple Regression	12	25%
Module-IV: Different Multivariate Probability distributions and Dimension Reduction Techniques	12	25%

Syllabus Outline: .....

Module I: Introduction to time series and estimation of trend and seasonal components: [14L]
Introduction, application of Time Series from various fields. Components of a Time Series (Trend, Seasonal and Cyclical patterns, Random error). Decomposition of Time Series - additive and multiplicative models. Estimation of Trend: free hand curve method, method of moving averages, fitting various mathematical curves and growth curves. Detrending. Estimation of seasonal component by method of simple averages, ratio-to-moving average, ratio-to-trend. Deseasonalization.

Module II: Introduction to stochastic modelling and different stationary processes: [10L]
Introduction to Stochastic modelling: Concept of Stationarity. Illustration of how a Stationary Time Series may show temporal patterns. Stationarity in mean. Auto-covariance (ACVF) and Auto-correlation functions (ACF) and their properties.Moving-average (MA) process and Autoregressive (AR) process of orders one and two. ACF and its graphical use in guessing the order of MA processes.

Module III: Multivariate Probability Distribution and Multiple Regression: [12L]
Definition of random vectors, probability distribution over multi-dimensional Euclidean space, joint CDF of a random vector and its properties, discrete and continuous random vectors, joint PMF and PDFs and their properties, relationship between joint and marginal distributions, conditional distributions and statistical independence. Mean vector and variance-covariance/dispersion matrix of a random vector, properties of dispersion matrix and associated results. Multiple regression related to multi-dimensional random vectors and associated results. Multiple linear regression model involving dependent random variables, expressions of the regression coefficients, error involved in a multiple linear regression model and its properties. Multiple correlation and partial correlation coefficients, their significance and associated results (statements only).

Module IV: Different Multivariate Probability distributions and Dimension Reduction Techniques: [12L]
Multinomial distribution & Multivariate normal distributions and their properties (statements only). Tests for Multiple and Partial correlation coefficients.Principal Component Analysis: introduction, objectives, geometrical significance, population principal components and associated results, principal components for standardized variables, Scree plot, summarizing sample variation by principal components. Factor Analysis: introduction, Orthogonal Factor Model along with its assumptions, concepts of common factors, specific factors, factor loadings and loading matrix, communality, specific variance. Methods of estimation: Principal Component method. Concept of Factor Rotation - Varimax Rotation.

Teaching–Learning Methodology: .....

- ***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.: Fundamentals of Statistics, Vol. I, 8th Edition. World Press, Kolkata.
2. Gun A.M., Gupta M.K. and Dasgupta B.: Fundamentals of Statistics, Vol. II, 8th Edition, The World Press Private Limited, Kolkata.

Reference Books:

1. Mukhopadhyay P. (1999): Applied Statistics, Books & Allied Pvt. Ltd.
2. Anderson T.W.: An Introduction to Multivariate Statistical Analysis, 3rd Edition, John Wiley & Sons, Inc.

Course Outcome (CO):

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

CO1: Describe the concepts of different components and models of a time series data.

CO2: Apply the trend and seasonal components using different methods.

CO3: Figure out moving average and auto regressive processes in forecasting.

CO4: Justify the knowledge of multivariate probability distributions to summarize a number of approaches to multivariate probability modelling, knowledge of multiple regression to measure the dependence between correlated random variables and concepts of the multiple correlation to measure the efficacy of a multiple linear regression model and partial correlation coefficients.

CO5: Develop different aspects of multivariate normal and multinomial distributions to model real-life complex datasets and the basic concepts and associated results of principal component analysis and basic ideas of factor analysis as a dimension reduction technique.

CO-PO-PSO Mapping:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	2	1	0	3	2	3	3	2
CO2	3	3	3	3	2	2	1	2	0	2	3	3	2	2
CO3	3	3	3	2	2	2	2	1	1	2	2	2	2	1
CO4	3	3	3	2	2	2	0	2	2	3	3	3	3	1
CO5	3	3	3	3	3	2	2	1	-	3	3	3	3	2

1: Slight (Low) *2: Moderate (Medium)* *3: Substantial (High)*