Syllabus of

BSc [AI & DS / AI & ML / CS]

I YEAR

Course Information Sheet

Course Code	:	SC25101
Course Title	:	Programming with C
Pre-requisite(s)	:	
Co-requisite(s)	:	C Programming Lab
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	I/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Recall the fundamentals and syntax of C programming.
B.	Understand the use of variables, control structures, and data types in C.
C.	Apply C programming constructs to solve computational problems.
D.	Analyze real-world problems and develop corresponding C programs.
E.	Create modular programs using functions, structures, and file operations.

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

CO1	Apply decision-making and loop constructs to solve basic problems.
CO2	Implement array operations to manipulate data efficiently.
CO3	Develop programs using user-defined and library functions.
CO4	Analyze and use pointers, structures, and unions effectively.
CO5	Design and implement file handling in C for data management

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Introduction to C Programming Overview of C Language: History and evolution, significance of C in programming, structure of a C program. Constants, Variables, and Data Types: C tokens: Keywords, identifiers, constants, strings, operators, and symbols. Data types: Primary data types and user-defined data types. Variable declaration and initialization.	7
Module-2: Operators, Expressions, and Control Flow Operators and Expressions**:** Types of operators: Arithmetic, relational, logical, assignment, increment/decrement, bitwise, conditional, and special operators. Arithmetic expressions, operator precedence and associativity, type conversions in expressions. Decision Making and Branching**:** Control statements: if, if-else, else-if ladder, nested if, switch, goto. Loop control statements: break, continue. Looping Constructs: while, do-while, and for loops.	7

Module-3: Arrays and Strings Arrays: Declaration and initialization of one-dimensional arrays. Two-dimensional and multi-dimensional arrays. Character Arrays and Strings: Declaring and initializing strings. Reading and writing strings: gets(), puts(). String manipulation functions and other string-related operations.	**7**
Module-4: Functions Function Basics: Definition, declaration, and function calls, Actual and Formal parameters, Nesting of functions, recursion, call by value and call by reference., Passing arrays and strings to functions.	**7**
Module-5: Structures, Unions and Pointers Structures and Unions: Defining structures, declaring and accessing structure variables. Arrays of structures and structures within arrays. Union: Definition and usage. Pointers: Concept of pointers, accessing addresses using pointers. Declaration of pointer variables and pointer expressions.	**7**

Text Books:

1. Balagurusamy E., "Programming in ANSI C", 8th Edition, TMH, 2019.
2. Gottfried B. S., "Programming with C", Schaum Series, McGraw Hill, 2005.
3. C How to Program, 9/E, deitel & deitel , Pearson Publication, 2022
4. Programming In C, Reema Thareja, OUP India

Reference Books:

1. Sprankle M., "Problem Solving and Programming Concepts", 7th Edition, Pearson Education, New Delhi, 2006.
2. Kanetkar Y., "Let us C", 19th Edition, BPB publication, New Delhi, 2022.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1	2	2	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	2	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	2	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code : SC25103
Course Title : Structured and Object-Oriented Programming
Pre-requisite(s) :
Co- requisite(s) : Structured and Object-Oriented Programming Lab
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week 03
Class : B.Sc. (Computer Science)
Semester / Level : I/1
Branch : Computer Science

Course Objectives
This course enables the students to:

A.	Impart the basic constructs in structured and object-oriented paradigms.
B.	Learn about different problems and the approach to solve them.
C.	Gain proficiency with the concepts of structured and object oriented programming.
D.	Apply these concepts to solve real world problems.
E.	Help solving real world problems through appropriate programming paradigms.

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

CO1	Choose the loops and decision-making statements to solve the problem.
CO2	Implement different Operations on arrays.
CO3	Use functions to solve the given problem and understand structures and unions.
CO4	Recognize the application of modular programming approach.
CO5	Comprehend various elements of object-oriented programming paradigm, propose solutions through inheritance and polymorphism. Identify appropriate data structure for the given problem and device solution using generic programming techniques.

Syllabus

MODULE	No. of Lectures (Hours)
Module-1: Overview of C: History of C, Importance of C, Structure of C program, Sample of C programs. Constant, Variable and Data types,Tokens . **Decision making and Branching:** Decision making with if statement ,switch statement, The ?: Operator, The go-to statement. **Decision making and Looping:** The while statement, The do statement, The for statement, Nesting of loops, jumps in loops: break, continue.	7
Module 2: Arrays: One - dimensional arrays, Declaration and assign value of one – dimensional arrays, two dimensional arrays, Declaration and assign value of two – dimensional arrays, Multi – dimensional arrays. **Character Arrays and String:** Declaring and initializing string variables, reading string from terminal, Comparison of two strings, String handling functions.	7

MODULE	No. of Lectures (Hours)
Module 3: User defined functions: Definition of function, Function calls, Function declaration, Category of functions, Nesting of functions, Recursion, passing arrays to functions, Passing strings to functions. **Structures:** Defining a structure, declaring structure variables, Accessing structure members, Arrays of structures, Arrays within structures.	7
Module 4: Overview of Object-Oriented Programming: Features of OOP, Classes and Objects, Constructors and Destructors, Static data members, Static member functions and objects, Inline function, Function with default arguments, Friend function.	7
Module 5: Inheritance: Types of Inheritance, Single Inheritance, Multiple Inheritance, Multi-Level Inheritance, Hierarchical Inheritance, Multipath Inheritance, Inheritance and constructors, **Polymorphism**: Function overloading, operator overloading, Dynamic Polymorphism, Virtual functions, Pure virtual functions, Abstract classes	7

Text Books:

1. Kanetkar Y., "Let us C", 17th Edition, BPB publication, New Delhi, 2020.
2. Balagurusamy E., "Object-Oriented Programming with C++", 8th Edition, TMH, 2021.

Reference Books:

1. Balagurusamy E., "Programming in ANSI C", 9th Edition, TMH, 2020
2. Herbert Scildt, C++, The Complete Reference, Tata McGraw-Hill

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1	1	2	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	1	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	1	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	2	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

CorrelationLevels1, 2 or 3 as defined below:

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

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25105
Course Title	:	Operating Systems
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	I/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to :

A.	Define core concepts and architecture of operating systems.
B.	Explain the components such as process, memory, and file systems.
C.	Analyze CPU scheduling and memory management strategies.
D.	Evaluate different OS mechanisms for process and file handling.
E.	Apply OS concepts to real-time computing environments

Course Outcomes

After the completion of this course, students will be able to:

CO1	Describe the functions and structures of an operating system.
CO2	Analyze process management and scheduling algorithms.
CO3	Examine deadlock conditions and recovery techniques.
CO4	Evaluate memory management schemes including paging and segmentation.
CO5	Illustrate file system concepts and implement basic file handling techniques

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Overview of OS, Evolution and history of OS, Types of OS, Functions and services provided by OS, Process concept, Process states and process life cycle, Process Control Block, Context Switching.	7
Module-2: CPU scheduling algorithms: First come first served (FCFS), Shortest job first (SJF), Round robin (RR) and Priority-based scheduling, Multi-level Scheduling, Multi-Level Feedback queue, Multi Processing Scheduling.	7
Module-3: Introduction to memory hierarchy, Primary and secondary memory, Contiguous and non-contiguous memory allocation, Paging and Segmentation.	7
Module-4: Introduction to virtual memory, Demand Paging and Demand Segmentation, Page fault, Page Replacement Algorithms, Thrashing.	7
Module-5: File concept, File Attributes and Types, File access methods, File allocation methods, Directory Structures, File protection methods.	7

Text Books:

1. Silberschatz A., Galvin P.B. & Gagne G., "Operating System Concepts", 10th Edition, Wiley India, 2018.

Reference Books:

1. D.M. Dhamdhere, Operating Systems: A concept Based Approach", Tata McGraw Hill 2nd Edition
2. Tanenbaum, "Operating Systems Design and Implementation", 3rd Edition., Prentice- Hall Inc., 2006

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (PO)												Program Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	3	3	3	2	1	1	2
CO2	3	1	1	1	1	3	1	1	3	1	1	1	1	3	1
CO3	2	3	3	1	2	1	2	2	2	3	3	1	2	1	2
CO4	1	1	3	3	1	1	1	1	1	1	3	3	1	1	1
CO5	3	3	3	1	2	1	1	2	3	3	3	1	2	1	1

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25107
Course Title	:	Fundamentals of Computing
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	2
Class schedule/ week	:	L:2 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	I/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives :
This course enables the students to:

A.	Identify the components and types of computer systems.
B.	Explain the role of operating systems and programming languages.
C.	Perform conversions and apply logic using number systems and Boolean algebra.
D.	Analyze input/output devices and memory units.
E.	Understand basic networking and software lifecycle models.

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

CO1	Recall fundamental concepts of hardware and software.
CO2	Explain operating system functions and programming paradigms.
CO3	Apply Boolean logic and number conversions.
CO4	Describe working of I/O devices and memory architecture.
CO5	Explain stages of software lifecycle and computer network basics

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Introduction to Computers: Definition, Characteristics of Computers, Classification of Computers, Analog-Hybrid-general purpose digital Computers, Applications of Computers. Computer Software: Software: Definition, Relationship between Software and Hardware, Software Categories, System Software, Application Software, Utility programs. Input Devices & Output Devices.	**5**
Module-2: Category of different Programming Languages, Steps for Developing a computer program, supporting tools like Algorithm, Flowchart, Pseudo Code(P-Code) for designing a computer program, Generations of Programming Languages.	**5**

Module-3: Number Systems and Logic Gates: Number Systems, Conversion between Number bases, Arithmetic System. Signed and Unsigned Numbers, Concept of Overflow, Binary Coding, Logic Gates, Boolean Algebra and Combination of Logic Gates.	**5**
Module-4: Computer Architecture: Central Processing Unit (CPU), Memory, Communication between various units of a Computer System, The Instruction Format, Instruction Set, Computer Memory: Primary Memory Hierarchy, Random Access Memory, Types of RAM, Read only memory (ROM), Types of ROM., Classification of Secondary Storage Devices, Magnetic Tape, Magnetic Disk, Optical Disk.	**5**
Module-5: The Software Engineering Discipline – Evolution and Impact, Programs vs. Software Products, Why Study Software Engineering? Software Life Cycles Models: Classical Waterfall Model, Prototyping Model, Spiral Model and Comparison of Different Life Cycle Models. Uses of Computer Networks, Needs and Advantages, Network Hardware devices.	**5**

Text Books:

1. ITL Education Solution Limited, R & D Wing, Introduction to Computer Science, Pearson Education.
2. Mano M., "Computer System Architecture", Prentice Hall of India, New Delhi,

Reference Books:

1. Raja Raman V, Fundamentals of Computers, Second Edition, PHI, New Delhi.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	1	1	2	2	2	2
CO3	3	3	3	3	3	1	2	2	1	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25109
Course Title	:	Fundamentals of Mathematics
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	I/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Recall basic concepts in geometry and coordinate systems.
B.	Apply linear equations and matrices to solve algebraic problems.
C.	Understand sets, functions, and their properties.
D.	Differentiate functions and apply them in optimization.
E.	Integrate functions and compute areas under curves.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand geometric interpretation of linear equations.
CO2	Solve linear equations using matrix algebra.
CO3	Explain set operations and function properties.
CO4	Apply differentiation for real-world applications.
CO5	Integrate functions and apply to area calculations

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Basics of Geometry : Cartesian system, coordinates, Point, Straight line and its different forms, Basics of Circle and Parabola. Plain and its equation. System of Linear equations in two variables and three variables and their solution along with geometrical interpretation.	**7**
Module-2: Introduction to Matrices and System of Linear Equations: Matrices, Algebra of Matrices (Addition, Subtraction, multiplication), Determinant and inverse of Matrices. Solving System of Linear using Matrices (Homogeneous/non-Homogenous), Gaussian Elimination method.	**7**
Module-3: Basics of Set and Function: Set, Venn diagram, Operations on Sets, Union, Intersection, complement, properties of set operations, Functions, one-one, onto, bijective function, identity function, composite of functions, inverse of function. Meaning of Continuous functions, polynomials and their roots.	**7**

Module-4: Differentiation: Functions (algebraic, trigonometric, geometrical, logarithmic, exponential) and their differentiation, rules of differentiation, sum rule, product rule, quotient rule and chain rule, Maxima minima of function with geometrical interpretation.	**7**
Module-5: Integration: Integration of functions, anti-derivative, Rules of integration, integration by substitution and integration by parts, Definite integration and Area under the Curve.	**7**

Text Books:

1. R.D. Sharma, "Mathematics for XI and XII Volume 1 and 2", Dhanpat Rai Publication.
2. B.S. Garewal, "Higher Engineering Mathematics", Khanna Publication.

Reference Books:

1. Thomas, G.B and Finney, R.L. , "Calculus and Analytic Geometry", Pearson.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	2	1	3	1	1	1	2	2	2	1	3	2	2	2
CO2	2	2	1	3	1	1	1	2	2	2	1	3	2	2	2
CO3	2	2	1	2	1	1	1	2	2	2	1	3	2	2	2
CO4	2	2	1	2	1	1	1	2	2	2	1	3	1	1	1
CO5	2	2	1	1	1	1	1	2	2	2	1	3	1	1	1

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25111
Course Title	:	Calculus
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P: 0
Class	:	B.Sc.(Computer Science)
Semester/Level	:	I/1
Branch	:	Computer Science

Course Objectives

This course enables the students to:

A.	Understand some basics of calculus
B.	Provide the basic understandings of partial derivative, total derivative and integration for the multiple variable functions and their applications in the Engineering and Sciences.
C.	Impart the knowledge of mathematical modeling for practical problems in Research and Development.
D.	Prepare the students background for the advance level of understanding of the use of mathematics in the different engineering disciplines.
E.	Enable the students to implement the basic differentiation and integration into the applied field of Engineering and Sciences.

Course Outcomes

After the completion of this course, students will be able to:

CO1	**Understand and apply** the fundamental concepts of single-variable calculus including Rolle's Theorem, Lagrange's Mean Value Theorem, and methods to determine maxima, minima, and points of inflection.
CO2	**Solve and interpret** ordinary differential equations (first-order, first-degree, and second-degree) and apply them in modeling real-world problems .
CO3	**Perform and analyze** multivariable calculus operations including partial differentiation, Taylor/Maclaurin expansions, and determine extrema of functions with two or more variables.
CO4	**Apply vector calculus concepts** such as gradient, divergence, curl, and directional derivatives to solve problems in scalar and vector fields.
CO5	**Evaluate multiple integrals** and apply vector integration theorems (Green's, Stokes's, and Gauss's Divergence Theorem) to compute physical quantities and solve field-related problems.

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Calculus of Single Variable: Lagrange's Mean Value Theorem, Rolle's Theorem, Increasing and decreasing Functions, Maxima and Minima: single derivative test, double derivative test, the point of inflection. Integration, Differential Equation of the First Order and First Degree, Differential equation of first order and second degree. Applications of the differential equations: Motion, Heat transfer, LR Circuit, LCR Circuit.	**7**

Module-2: Multiple Variable Differentiation: Partial Differentiation, Euler's theorem, Taylor's Expansion, Maclaurin's Expansion, Maxima and Minima of the multi-variate functions, the point of inflection.	**7**
Module 3:Vector Differentiation: Scalar and Vector Valued Functions, Directional Derivative, Gradient of a Function, Divergence of a Function, Curl of a Function, Scalar and Vector Potentials. Simple problems	**7**
Module 4:Multiple Integration: Double Integration, Triple Integration, Change of Coordinate system of Integration, Change of Order of Integration, Green's Theorem, Stokes's theorem, Gauss' Divergence theorem.	**7**
Modue 5:Partial Differential Equation: Creating the Partial Differential Equations, Partial Differential Equation of First Order, Partial Differential Equation of Second order, Applications of Partial Differential Equations, Heat Transfer, Wave Equations.	**7**

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.

Reference Books:

1. George B. Thomas, D. Weir, and J. Hass, Thomas Calculus, 2014, 13th Edition, Pearson.
2. John Bird, Higher Engineering Mathematics, 2017, 6th Edition, Elsevier Limited.
3. James Stewart, Calculus: Early Transcendental, 2017, 8th Edition, Cengage Learning.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	3	3	2	2	2	1	1	1	2	1	3	2
CO2	3	3	1	3	2	1	3	1	1	1	2	2	2	3	1
CO3	3	3	3	2	3	1	2	3	1	1	2	1	2	2	3
CO4	3	2	3	3	1	1	1	1	1	2	1	1	2	3	2
CO5	2	3	3	2	3	3	1	2	2	1	1	2	2	1	3

CorrelationLevels1, 2 or 3 as defined below:

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

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25121
Course Title	:	Quantitative Skills
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:2 T: 0 P: 2
Class	:	B.Sc. (Computer Science)
Semester/Level	:	I/1
Branch	:	Computer Science

Course Objectives

This course enables the students to:

A.	Enhance the logical reasoning skills of the students and help them improve problem-solving abilities
B.	Acquire skills required to solve quantitative aptitude problems
C.	Boost the verbal ability of the students for academic and professional purposes
D.	Enable the students to apply the reasoning skills in arithmetic problem solving
E.	Enable the students to apply the basic arithmetic concepts to solve real world problem.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Exhibit sound knowledge to solve problems of Quantitative Aptitude
CO2	Demonstrate ability to solve problems of Logical Reasoning
CO3	Display the ability to tackle questions of Verbal Ability
CO4	Solve the arithmetic problems with quantitative technique.
CO5	Enhance the logical reasoning skills for problem solving

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module 1: Logical Reasoning: Word group categorization questions Puzzle type class involving students grouping words into right group orders of logical sense, image ordering, pattern recognition, Cryptarithmetic	7
Module 2: Ratio and Proportion: Ratio - Proportion - Variation - Simple equations - Problems on Ages - Up Streams and Down Streams, Distance-Time, Speed variation.	7
Module 3: Percentages, Simple and Compound Interest: Percentages as Fractions and Decimals - Percentage Increase/ Decrease - Simple Interest - Compound Interest - Relation Between Simple and Compound Interest	7

Module 4: Number System: Number system- Power cycle - Remainder cycle - Factors, Multiples - HCF and LCM	**7**
Modue 5: Combinatorics: Introduction to permutations and combinations. Relation between permutations and combinations, circular permutations, word problems in permutations and combinations.	**7**

Text Books:

1. Aggarwal R.S. (2017). *Quantitative Aptitude for Competitive Examinations* 3rd (Ed.). New Delhi: S. Chand Publishing.

Reference Books:

1. SMART. (2018). *Place Mentor* 1st (Ed.). Chennai: Oxford University Press.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	3	2	3	3	2	2	2	1	1	2	2	1	3	2
CO2	3	3	1	3	2	1	3	1	1	1	1	2	2	3	1
CO3	3	2	3	2	3	2	2	3	1	1	2	1	2	2	3
CO4	3	1	3	2	1	1	2	2	2	2	1	1	2	3	2
CO5	2	2	3	1	3	3	1	2	2	1	1	2	2	1	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Code	:	SC25131
Course Title	:	Design Thinking
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	2
Class schedule/ week	:	L:2 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	I/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Understand design thinking principles and mindset.
B.	Apply empathy techniques for user-centric problem analysis.
C.	Generate and ideate creative solutions using design frameworks.
D.	Build and iterate prototypes using user feedback.
E.	Integrate data and stakeholder insights for design evaluation

Course Outcomes

After the completion of this course, students will be able to:

CO1	**Empathize**: Apply empathy techniques to understand user needs and define human-centered problems.
CO2	**Define:** Formulate clear problem statements and "How Might We" questions from user research.
CO3	**Ideate:** Generate a wide variety of creative solutions using ideation techniques.
CO4	**Prototype & Test:** Build and test low-fidelity prototypes and iterate based on feedback.
CO5	**Integrate Data:** Integrate basic data insights and stakeholder feedback in the design process.

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Introduction to Design Thinking: Evolution of Design Thinking—history and key schools, The Design Thinking Mindset—empathy, experimentation, bias to action, Human-Centered Design vs. Traditional Problem Solving, Framing Wicked Problems, Overview of the Five-Stage Process (Empathize, Define, Ideate, Prototype, Test), Case Studies: Design Thinking in Tech & Healthcare	**5**
Module-2: Empathize & Define: User Research Methods—interviews, observation, contextual inquiry, Empathy Mapping & Journey Mapping, Synthesizing Qualitative Data—clustering and affinity diagrams, Crafting Point-of-View (POV) Statements, Defining Problem Statements & "How Might We" Questions, Aligning Business Goals with User Needs. Decision Making and Branching: Control statements: if, if-else, else-if ladder, nested if, switch, goto. Loop control statements: break, continue. Looping Constructs: while, do-while, and for loops.	**5**
Module-3: Ideation Techniques –Brainstorming Best Practices & Rules, Alternative Ideation Methods: SCAMPER, Crazy 8's, Mind Mapping, Co-creation Workshops & Stakeholder Involvement, Selecting & Prioritizing Ideas—Impact/Effort Matrix, Storyboarding Solutions, Integrating Quantitative Insights into Ideation	**5**

Module-4: Prototyping Strategies –Fidelity Spectrum: From Paper to Digital Prototypes, Rapid Prototyping Tools & Techniques, Storyboards & Role-Playing as Prototype Methods, Lean Experimentation & Build-Measure-Learn, Incorporating Data Feedback Loops, Ethical Considerations in Prototyping	**5**
Module-5: Testing, Iteration & Implementation –Planning & Conducting Usability Tests, Analyzing Feedback & Defining Metrics of Success, Iteration Strategies & Pivot vs. Persevere Decisions, Scaling Solutions & Handoff to Development, Measuring Impact & Continuous Improvement, Final Project Presentations & Reflection.	**5**

Text Books:

1. Idris Mootee, Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, 2013, Wiley
2. Kristina Niedderer, Stephen Clune, Geke Ludden, Design Thinking for Student Projects: A Framework for Innovation and Entrepreneurship, 2021. Routledge
3. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, 2018 Wiley

Reference Books:

1. Ben Shneiderman, Human-Centered AI, 2022, Oxford University Press
2. Jake Knapp (Google Ventures), Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days, 2016, Simon & Schuster
3. Dan Saffer, Designing for Interaction: Creating Smart Applications and Clever Devices, 2020 (4th Ed.), New Riders
4. Stickdorn, Hormess, Lawrence, Schneider, This is Service Design Doing: Applying Service Design Thinking in the Real World, 2018, O'Reilly

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	1	1	2	2	2	3	2	1	2	2	3	3
CO2	3	3	2	1	1	1	1	2	2	2	1	2	2	3	2
CO3	2	3	3	1	2	2	1	1	2	2	1	2	3	3	2
CO4	2	3	3	2	3	2	1	1	3	3	2	2	3	3	2
CO5	2	2	3	3	3	2	2	2	2	3	2	3	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25102
Course Title	:	C Programming Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	I/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives
This course enables the students to:

A.	Understand the basics of coding using C language.
B.	Apply fundamental programming techniques to solve problems.
C.	Develop programs for algorithm-based logic.
D.	Analyze program errors and debugging approaches.
E.	Create structured C programs using modular design.

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

CO1	Formulate simple algorithms for arithmetic/logical problems.
CO2	Convert algorithms into syntactically correct C programs.
CO3	Test and debug logical and syntax errors in C.
CO4	Apply C programming for numerical methods like integration.
CO5	Construct modular programs using functions and structures

SYLLABUS

Module-1: Basics of C Programming
Objective: To familiarize students with basic syntax, data types, variables, and program structure.
Lab Exercises:

1. Write a C program to demonstrate the use of variables and constants.
2. Write a C program to use different data types and print their sizes.
3. Write a C program to take input of various data types and display them.
4. Write a program to demonstrate the use of different types of C tokens (identifiers, keywords, constants, etc.)

Module-2: Operators, Expressions, and Control Flow
Objective: To understand operators, expressions, decision-making, and loops in C.
Lab Exercises:

1. Write a C program to demonstrate all arithmetic and logical operators.
2. Write a program to evaluate an expression and display the result (with proper operator precedence).
3. Write a C program to find the largest of three numbers using if-else.
4. Write a C program to print the grade of a student using switch-case.
5. Write a program to illustrate the use of for, while, and do-while loops.

6. Write a program to demonstrate break, continue, and goto statements within loops.
7. WAP to find whether a given year is a leap year or not. Modify it to generate a list of leap years between two-year limits given by user
8. Using Ternary / Conditional operator find the greatest among 3 numbers.

Module-3: Arrays and Strings
Objective: To learn declaration, initialization, and manipulation of arrays and strings.
Lab Exercises:

1. Write a C program to find the sum and average of elements in an array.
2. Write a program to search an element in an array and print its position.
3. Write a C program to perform matrix addition or multiplication using 2D arrays.
4. Write a C program to read and display a string using gets() and puts().
5. Write a C program to demonstrate the use of string handling functions like strlen(), strcpy(), strcat(), and strcmp().

Module-4: Functions
Objective: To develop modular programs using functions and understand parameter passing.
Lab Exercises:

1. Write a program using functions to find the factorial of a number.
2. Write a recursive function to generate the Fibonacci series.
3. Write a function to swap two numbers using call by value and call by reference.
4. Write a function to find the sum of elements in an array passed as argument.
5. Write a function to count vowels in a given string.
6. Write an interactive program that will read in a +ve integer value and determine the following
    a) If the integer is a prime number
    b) If the integer is a Fibonacci number

Module-5: Structures, Unions, and Pointers
Objective: To explore user-defined data types and dynamic memory access using pointers.
Lab Exercises:

1. Define a structure Student with members (name, roll no, marks). Write a program to read and display student details.
2. Write a program to create an array of structures for 5 students and print the average marks.
3. Write a program using a structure within a structure (nested structures).
4. Write a program to demonstrate pointer basics: address and dereferencing.
5. Write a program to pass a structure variable to a function using a pointer.
6. Write a program to demonstrate use of union and compare it with structure.

Text Books:

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
2. Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill.
3. C How to Program, 9/E, deitel & deitel , Pearson Publication, 2022
4. Programming In C, Reema Thareja, OUP India

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall India Learning Private Limited.
2. Jery R Hanly, “Problem solving and Program design in C”, Pearson Education, 7th Edition.
3. R. G. Dromey, How to Solve it by Computer, Pearson Education.
4. Sprankle M., “Problem Solving and Programming Concepts”, 7th Edition, Pearson Education, New Delhi, 2006.
5. Kanetkar Y., “Let us C”, 4th Edition, BPB publication, New Delhi, 2002.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25104
Course Title	:	Structured and Object-Oriented Programming Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (Computer Science)
Semester/Level	:	I/1
Branch	:	Computer Science

Course Objectives

This course enables the students to:

A.	Learn computer language.
B.	Learn coding for problems.
C.	Learn the problem-solving process through computer.
D.	Know the limitations of system during program execution.
E.	Know the practical application of various programming techniques.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Formulate simple algorithms for arithmetic and logical problems.
CO2	Translate the algorithms to programs.
CO3	Test and execute the programs and correct syntax and logical errors.
CO4	Apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	Decompose a problem into functions and synthesize a complete program using divide and conquer approach.

SYLLABUS

Module-1: Basics of C Programming

Objective: To familiarize students with basic syntax, data types, variables, program structure, decision making and loops.

Lab Exercises:

1. Write a C program to demonstrate the use of variables and constants.
2. Write a C program to use different data types and print their sizes.
3. Write a C program to take input of various data types and display them.
4. Write a program to demonstrate the use of different types of C tokens (identifiers, keywords, constants, etc.)
5. Write a C program to demonstrate all arithmetic and logical operators.
6. Write a program to evaluate an expression and display the result (with proper operator precedence).
7. Write a C program to find the largest of three numbers using if-else.
8. Write a C program to print the grade of a student using switch-case.
9. Write a program to illustrate the use of for, while, and do-while loops.
10. Write a program to demonstrate break, continue, and goto statements within loops.

Module-2: Arrays and Strings
Objective: To learn declaration, initialization, and manipulation of arrays and strings.
Lab Exercises:

1. Write a C program to find the sum and average of elements in an array.
2. Write a program to search an element in an array and print its position.
3. Write a C program to perform matrix addition or multiplication using 2D arrays.
4. Write a C program to read and display a string using gets() and puts().
5. Write a C program to demonstrate the use of string handling functions like strlen(), strcpy(), strcat(), and strcmp().

Module-3: : Functions and Structures
Objective: To develop modular programs using functions and understand parameter passing.
Lab Exercises:

1. Write a program using functions to find the factorial of a number.
2. Write a recursive function to generate the Fibonacci series.
3. Write a function to swap two numbers using call by value and call by reference.
4. Write a function to find the sum of elements in an array passed as argument.
5. Write a function to count vowels in a given string.
6. Write an interactive program that will read in a +ve integer value and determine the following
   a) If the integer is a prime number
   b) If the integer is a Fibonacci number
7. Define a structure Student with members (name, roll no, marks). Write a program to read and display student details.
8. Write a program to create an array of structures for 5 students and print the average marks.
9. Write a program using a structure within a structure (nested structures).

Module-4 Overview of Object Oriented Programming
Objective: To develop programs using OOPS concepts
Lab Exercises:

1. Create a class **`Rectangle`** with length and breadth as data members. Include functions to calculate area and perimeter.
2. Write a program to create a class **`Book`** with data members: title, author, and price. Use a constructor to initialize them and display book details.
3. Define a class **`Student`** with marks of 3 subjects. Include functions to calculate and display total and average marks.
4. Create a class **`BankAccount`** with account number, holder name, and balance. Write functions to deposit and withdraw money
5. Write an inline function to calculate the cube of a number.
6. Create a class **`Math`** with inline functions to calculate square and factorial of a number.

Module-5: Inheritance and Polymorphism
Objective: To develop programs using OOPS concepts
Lab Exercises:

Single Inheritance

1. Create a class Person with name and age. Derive a class Student that adds roll number and marks. Accept and display details using both classes.
2. Create a base class Shape with a function to display area. Derive classes Rectangle and Circle to calculate and display respective areas.

Multilevel Inheritance

3. Create a class University, derive Department from it, and then derive Student from Department. Display data from all levels.
4. Design a class hierarchy where Employee is the base class, Manager is derived from Employee, and SeniorManager is derived from Manager. Show how data flows through the hierarchy.

Multiple Inheritance

5. Create two classes Teacher and Researcher. Derive a class Professor from both, and show how it inherits properties of both.

6. Create classes Sport and Academics with marks. Derive a class Result that displays total marks using multiple inheritance.

Hierarchical Inheritance

7. Create a base class Account and derive SavingsAccount and CurrentAccount. Each derived class should have its own features. Display complete account details.

Compile-Time (Function Overloading)

8. Create a class Calculator with multiple overloaded add() functions to add two integers, two floats, and three numbers.
9. Overload a function area() to compute area of circle, rectangle, and triangle.

Run-Time (Virtual Functions / Function Overriding)

10. Create a base class Animal with a virtual function makeSound(). Derive classes Dog and Cat that override the function to give respective sounds.
11. Create a class Vehicle with a virtual function startEngine(). Derive classes Car and Bike, override the function, and invoke through a base class pointer.

Text Books:

1. Kanetkar Y., "Let us C", 17th Edition, BPB publication, New Delhi, 2020.
2. Balagurusamy E., "Object-Oriented Programming with C++", 8th Edition, TMH, 2021.

Reference Books:

1. Balagurusamy E., "Programming in ANSI C", 9th Edition, TMH, 2020
2. Herbert Scildt, C++, The Complete Reference, Tata McGraw-Hill

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25113
Course Title	:	Introduction to Data Structures
Pre-requisite(s)	:	
Co-requisite(s)	:	Data Structures Lab
Credits	:	4
Class schedule/ week	:	L:3 T: 1 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	II/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Recall fundamentals of algorithms and data structures.
B.	Understand various data types and storage mechanisms.
C.	Apply appropriate data structures for different problems.
D.	Analyze time-space complexities of algorithms.
E.	Evaluate real-life applications using data structures

Course Outcomes

After the completion of this course, students will be able to:

CO1	Analyze algorithm efficiency and data structure properties.
CO2	Apply data structures for modeling computer-based systems.
CO3	Implement and evaluate tree-based structures.
CO4	Select appropriate searching and sorting algorithms.
CO5	Solve real-world problems using graph algorithms

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Introduction: Introduction to Algorithmic, Asymptotic notations, Complexity-Time- Space Trade off. Data Structure-Definition and classification. Arrays: Representation of Arrays in Memory: Accessing elements of array, performing operations like insertion, deletion, arranging elements and searching, applications of arrays.	**8**
Module-2: Stacks and Queues: Introduction to data structures like Stacks and Queues. Operations on Stacks and Queues, Array representation of Stacks, Applications of Stacks: Operations of Queues, Representations of Queues, and Applications of Queues.	**8**
Module-3: Linked Lists: Singly linked lists, Representation of linked list, Operations of Linked list such as Traversing, Insertion and Deletion, Searching, Applications of Linked List. Concepts of Circular linked list and doubly linked list and their Applications, Stacks and Queues as linked list.	**8**

Module-4: Trees: Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching, Insertion and Deletion, Applications of Binary search Trees, Complete Binary trees. Graphs: Terminology and Representations, Adjacency Matrix and Adjacency List Representation, Directed Graphs and Undirected Graphs.	**8**
Module-5: Searching and Sorting: Definition. Linear Search, Binary search, Interpolation Search, Transpose Sequential Search. Insertion sort, Selection sort, Quick sort, Merge sort.	**8**

Text Books:

1. Horowitz and Sahni, "Fundamentals of Data structures", Galgotia publications.
2. Pai GAV,"Data Structures and Algorithms: Concepts, Techniques and Applications", Tata McGraw-Hill.

Reference Books:

1. Tannenbaum, "Data Structures", PHI.
2. Lipschutz Seymour, "Data Structures", Tata McGraw-Hill.
3. Dozed Adam, "Data Structures and Algorithms in C++", Thomson Learning.
4. R.L.Kruse, B.P.Leary, C.L.Tondo, "Data structure and program design in C", PHI,
5. Michael T. Goodrich, "Data Structures and Algorithms in C++", Wiley India Edition.
6. Tremblay J. P., Sorenson P. G, "An Introduction to Data Structures with Applications", McGraw-Hill.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	2	2	2	2	3	3	3	3	1	2	2
CO2	3	3	3	2	2	3	2	1	3	2	3	3	3	2	3
CO3	3	3	3	3	2	2	2	2	2	2	3	3	2	2	3
CO4	2	2	2	3	1	2	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	3	3	3	3	1	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25115
Course Title	:	Python Programming
Pre-requisite(s)	:	
Co-requisite(s)	:	Python Programming Lab
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	II/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Understand fundamental programming concepts using Python.
B.	Apply control structures and standard functions effectively.
C.	Use built-in data structures for efficient problem-solving.
D.	Implement OOP principles using Python classes and objects.
E.	Handle file operations and exceptions for robust programs.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Solve computational problems using Python basics.
CO2	Utilize control flow and standard functions efficiently.
CO3	Implement and manipulate data structures like lists and dictionaries.
CO4	Apply OOP concepts in program design.
CO5	Perform data storage and manipulation using file handling

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Introduction to Python Programming: Introduction, Programming Languages, Features of python language, Getting Started with Python, Programming Errors. Writing a Simple Program, Reading Input from the Console, Identifiers, Variables, Assignment Statements, and Expressions, Simultaneous Assignments, Named Constants, Numeric Data Types and Operators, Evaluating Expressions and Operator Precedence, Augmented Assignment Operators, Type Conversions and Rounding.	7
Module-2: Mathematical Functions, Strings, and Objects: Introduction, Common Python Functions, Strings and Characters, Introduction to Objects and Methods, Formatting Numbers and Strings. Control Structures: Selections: Introduction, Boolean Types, Values, and Expressions, if Statements, Two-Way if-else Statements, Nested if and Multi-Way if-elif-else Statements, Logical Operators, Conditional Expressions, Loops: Introduction, The while Loop, The for Loop, Nested Loops, Keywords break and continue. Looping Constructs**:** while, do-while, and for loops.	7

Module-3: Functions: Introduction, Defining a Function, Calling a Function, Functions with/without Return Values, Positional and Keyword Arguments, Passing Arguments by Reference Values, The Scope of Variables, Default Arguments, Returning Multiple Values. Lists and Arrays :Introduction, List Basics, Copying Lists, Passing Lists to Functions, Returning a List from a Function, Searching Lists, Sorting, Processing Two-Dimensional Lists, Passing Two-Dimensional Lists to Functions, Multidimensional Lists. List to Array conversion and array operation using numpy module.	**7**
Module-4: Tuples, Sets, and Dictionaries: Introduction, Tuples: Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Tuple methods, Sets: Creating Sets, Manipulating and Accessing Sets, Subset and Superset, Set Operations, Comparing the Performance of Sets and Lists, Dictionaries: Creating a Dictionary, Adding, Modifying, and Retrieving Values, Deleting Items, Looping Items, The Dictionary Methods.	**7**
Module-5: Objects and Classes: Introduction, Defining Classes for Objects, Immutable Objects vs. Mutable Objects, Hiding Data Fields, Class Abstraction and Encapsulation, Object-Oriented Thinking. Inheritance and Polymorphism: Introduction, Superclasses and Subclasses, Overriding Methods. Files and Exception Handling: Introduction, text input and ouput : opening a file, Writing Data, Testing a File's Existence, Reading All Data from a File, Writing and Reading Numeric Data, Binary IO Using Pickling, Reading and writing CSV file using pandas, Exception Handling, Raising Exceptions.	**7**

Text Books:

1. Y. Daniel Liang, "Introduction to programming using python", Pearson Education; First edition (2017).

Reference Books:

1. Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education; Forth edition (2018)
2. Fabio Nelli "Python Data Analytics: With Pandas, NumPy, and Matplotlib" *Second Edition* Apress Media LLC
3. Mark Summerfield, "Programming in Python 3: A Complete Introduction to the Python Language" Pearson Education; Second edition (2018)

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	3	1	2	2	1	2	2	2	2	2	2	2
CO2	3	3	2	2	1	3	2	1	2	3	1	2	2	2	2
CO3	3	3	2	2	1	3	1	1	3	2	2	2	2	2	2
CO4	3	3	2	3	1	2	1	1	2	3	2	3	2	2	3
CO5	3	3	2	3	1	2	2	1	2	2	3	2	2	2	2

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25117
Course Title	:	Mathematics for Computing
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	II/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Recall foundational concepts of probability and statistics.
B.	Analyze and represent data using statistical tools.
C.	Understand discrete and continuous probability distributions.
D.	Apply sampling techniques and parameter estimation.
E.	Evaluate hypotheses using standard testing methods.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Apply basic probability rules and Bayes' theorem.
CO2	Visualize and interpret statistical data.
CO3	Work with discrete and continuous distributions.
CO4	Estimate population parameters using sampling techniques.
CO5	Perform hypothesis testing in decision-making

SYLLABUS

MODULE	No. Of Lectures (Hours)
Module-1: Probability: Basics of Probability, Sum and Product Rule, Conditional Probability, Independent event, Bayes theorem.	7
Module-2: Basics of Statistics: Statistics, Data Collection and representation (Descriptive Statistics), Bar Chart, Histogram, Ogive, Pie Chart, Steam- leaf representation. Mean, Mode, Median (percentile, Quartile and Box Plot), Deviation, Variance and Standard Deviation.	7
Module-3: Random Variable: Discrete Random Variable, Bernoulli and Poisson Distribution, Mean and Variance. Continuous Random Variable, Expectation and Variance, Moment, Normal Distribution, Uniform distribution, Exponential distribution.	7
Module-4: Sampling Distribution and Estimation of Parameters **:** Purpose and Principal of Sampling, Central Limit Theorem, Sampling distribution, Mean of Sampling Distribution and its variance, Sampling distribution of difference of mean, Meaning of Statistical estimation, Method of Maximum Likelihood, point and Interval Estimation, confidence limits for population mean.	7
Module-5: Hypothesis Testing: Significance Level, Procedure of Testing hypothesis, Testing hypothesis about the population mean, Testing hypothesis about the difference in two means, Types of errors.	7

Text Books:

1. Sheldon, M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier.
2. Walpole, Myers, Myers, Ye, "Probability and Statistics for Engineers and Scientists", Prentice, Hall.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	2	1	3	1	1	1	2	2	2	1	3	2	2	2
CO2	2	2	1	3	1	1	1	2	2	2	1	3	2	2	2
CO3	2	2	1	2	1	1	1	2	2	2	1	3	2	2	2
CO4	2	2	1	2	1	1	1	2	2	2	1	3	1	1	1
CO5	2	2	1	1	1	1	1	2	2	2	1	3	1	1	1

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25114
Course Title	:	Data Structures Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	Introduction to Data Structures
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	II/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Recall and implement core data structures using C.
B.	Apply data structures to solve standard algorithmic problems.
C.	Analyze performance of sorting and searching techniques.
D.	Use graphs and trees for problem modeling.
E.	Demonstrate real-world application of data structures.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify suitable data structures for given problems.
CO2	Measure time and space complexity of implementations.
CO3	Implement various sorting and searching algorithms.
CO4	Use trees and graphs to solve problems efficiently.
CO5	Justify design decisions for problem-specific data structures

SYLLABUS

Module-1: Arrays and Strings: Implement static and dynamic arrays, In-place array reversal, rotation, sorting (bubble, selection, insertion), Basic string operations: palindrome check, substring search, 2D arrays: matrix operations, transposition, diagonal sums
Module-2: Linked Lists: Singly Linked List: Create, insert, delete, traverse, Doubly Linked List: Insert at beginning, end, delete node, Circular Linked List implementation, Reversal and searching in linked lists
Module-3: Stacks and Queues: Implement stack using arrays and linked lists, Infix to postfix conversion, postfix expression evaluation, Implement queues: simple, circular, and dequeue (double-ended queue), Priority queues basics
Module-4: Trees and Recursion: Binary Tree creation, Preorder, Inorder, Postorder traversals (recursive and iterative), Binary Search Tree (BST): insert, search, delete, Height, leaf count, depth of tree
Module-5: Graphs and Hashing: Graph representation: adjacency matrix and list, BFS and DFS traversals, Detect cycles in undirected and directed graphs, Hash tables: chaining and open addressing, Collision resolution strategies

Text Books:

1. Baluja, G. S. Data Structure through C. New Delhi: Ganpat Rai Publications.
2. Pai, G. A. V. Data Structures and Algorithms: Concepts, Techniques and Applications. Tata McGraw-Hill.
3. Horowitz, E., Sahni, S., & Susan, A. Fundamentals of Data Structures in C. University Press.

Reference Books:

1. Tremblay, J. P., & Sorenson, P. G. An Introduction to Data Structures with Applications. McGraw-Hill.
2. Lipschutz, S. Data Structures. Tata McGraw-Hill.
3. Drozdek, A. Data Structures and Algorithms in C++. Thomson Learning, New Delhi.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

Course Information Sheet

Course Code	:	SC25116
Course Title	:	Python Programming Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	Python Programming
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	II/1
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Understand practical implementation of Python basics.
B.	Develop programs using control flow and data types.
C.	Apply data structures like lists, sets, tuples and dictionaries.
D.	Demonstrate object-oriented programming in Python.
E.	Perform file handling and data manipulation using Python libraries

Course Outcomes

After the completion of this course, students will be able to:

CO1	Write basic programs using operators and data types.
CO2	Implement control structures and logic-based tasks.
CO3	Manipulate data using Python data structures.
CO4	Build class-based programs demonstrating OOP features.
CO5	Handle files and process data using pandas and CSV modules.

SYLLABUS

Module-1:
Implementation of mathematical operations using python, Use of various operators in python, Using type conversion, python built in functions.

Module-2:
Implementation of If-else_elif structures, Nest if-else structures, Iterative programs to display pyramid patterns etc Using of Jump statements etc.

Module-3:
Implementation of functions: Writing function for factorial, gcd, lcm and Fibonacci etc. Recursive functions concept. Implementation of List Basics, Copying Lists, Searching Lists, Sorting, Processing Two-Dimensional Lists Multidimensional Lists. List to Array conversion and array operation using numpy module.

Module-4:
Implementation of Tuples, Sets, and Dictionaries in python: Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Tuple methods, Sets: Creating Sets, Manipulating and Accessing Sets, Set operations Dictionaries: Creating a Dictionary, Adding, Modifying, and Retrieving Values, Deleting Items, Looping Items, The Dictionary Methods.

Module-5:
Implementation of Programs on Defining Classes for Objects, Inheritance, and polymorphism, text input and ouput: opening a file, Writing Data, Testing a File's Existence, Reading All Data from a File, Using the pandas for operation on CSV file, Programming to implement exception handling.

Text Books:

1. Y. Daniel Liang, "Introduction to programming using python", Pearson Education; First edition (2017).
2. Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education; Forth edition (2018)

Reference Books:

1. Fabio Nelli "Python Data Analytics: With Pandas, NumPy, and Matplotlib" *Second Edition* Apress Media LLC
2. Mark Summerfield, "Programming in Python 3: A Complete Introduction to the Python Language" Pearson Education; Second edition (2018)

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	1	1	1	2	1	1	2	2	2	2	2	2	2
CO2	3	3	2	1	2	2	1	1	2	3	1	2	2	2	2
CO3	3	1	2	1	2	2	1	2	3	2	2	2	2	2	2
CO4	3	3	3	1	2	2	2	2	2	3	2	3	2	2	3
CO5	3	3	3	2	2	2	3	2	2	2	3	2	2	2	2

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

II YEAR

COURSE INFORMATION SHEET

Course Code : SC25201
Course Title : Data Analytics and Visualization
Pre-requisite(s) :
Co-requisite(s) : Data Analytics Lab
Credits : 3
Class schedule/ week : L:3 T: 0 P: 0
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : III/2
Branch : AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Command a conceptual understanding and the ability to manage different aspects of the survey research process
B.	Understand application of software for data analytics and management.
C.	Adopt appropriate statistical procedures to conduct analyses depending on the research goals and the nature of survey data
D.	Develop insights based on analytical results to better understand attitudes, perceptions and behaviour
E.	Understand the Role of Business Analytics in the Marketplace: Gain insight into how business analytics drives strategic decision-making and competitive advantage.

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

CO1	Process raw data to make it suitable for various data mining algorithms
CO2	Discover and measure interesting patterns from different kinds of databases.
CO3	Apply the techniques of clustering, classification, association finding, and visualization to real world data.
CO4	Interpret the contribution of data analysis to the decision-support level of organizations
CO5	Propose data-visualizations solutions for different applications

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 : Introduction to the principles and techniques for data visualization, Design principles for charts and graphs, Common tools for creating data visualizations (Excel, PowerPoint, R and visualization library)	7
Module 2 : The process creating visualizations and selecting the appropriate visual display, hands on with R/python, One-dimensional analysis using bar plot, pie chart, histogram, box plot, Two dimensional analysis using scatter diagram,	7
Module 3 : Statistical data analysis, Measures of central tendency, measures of dispersion, skewness, kurtosis, summary tables, cumulative statistics, contingency table	7
Module 4 : Predictive Analysis in R , Linear regression, decision tree, random forest	7
Module 5 : Introduction to tableau, Dashboard design, Interactive visualizations and motion, create multiple versions of digital visualizations using various of software packages	7

Text Books:
1.Wong, D. (2011). The Wall Street Journal guide to information graphics: The dos presenting data, facts and figures. New York: W.W. Norton & Company. Available at the NYU Bookstore
2. The Book of R: A First Course in Programming and Statistics by Tilman M. Davies, No Starch Press, 2016
3. R Programming for Data Science by Roger Peng, Lulu.com, 2012

Reference Books:
1. Few, S. (2012). Show me the numbers: Designing tables and graphs to enlighten. Burlingame, CA
2. Yau, N. (2013). Data Points: Visualization that means something. Indianapolis: Available at the NYU Book store Analytics Press.
3. Beginning R: The Statistical Programming Language by Mark Gardener, John Wiley & Sons, Inc., 2012

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure
DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	1	2	1	2	3	2	1	2	2	2	1	2	1
CO2	3	1	1	1	2	3	2	2	1	2	2	3	1	2	2
CO3	1	3	2	2	1	2	3	1	2	2	1	2	2	3	3
CO4	2	1	3	3	2	1	2	3	3	1	1	3	2	3	1
CO5	3	2	2	2	1	2	1	2	3	1	3	1	3	1	2

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4, CD5, CD6, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD4, CD5, CD6, CD8
CD3	Seminars	CO3	CD1, CD2, CD4, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD4
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25203
Course Title : Database Design Concepts
Pre-requisite(s) :
Co-requisite(s) : Database Design Lab
Credits : 3
Class schedule/ week : L: 3 T: 0 P: 0
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : III/2
Branch : AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand the purpose, architecture, models, and languages of database systems.
B.	Analyze entity–relationship models, relational data models, and their constraints for effective database design.
C.	Apply normalization techniques and functional dependency concepts for relational database schema refinement.
D.	Evaluate query processing strategies, cost measures, and optimization techniques for efficient query execution.
E.	Demonstrate concurrency control, transaction management, and recovery mechanisms in multi-user environments.

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

CO1	Explain the purpose, architecture, components, and users of database systems, including transaction management.
CO2	Develop ER diagrams, identify keys, apply constraints, and transform conceptual designs into relational schemas.
CO3	Apply normalization (1NF, 2NF, 3NF, BCNF, 4NF) and functional dependency concepts to achieve an optimized database design.
CO4	Analyze query evaluation strategies, estimate query costs, and compare optimization techniques for efficient query processing.
CO5	Implement transaction management and concurrency control mechanisms to ensure consistency, isolation, and recoverability in databases.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 : Introduction: Purpose of Database Systems, View of Data, Data Models, Database Languages, Relational Database, Database Architecture, Database Users and Administrators, Transaction Management.	7
Module 2 : Relational Data Models and Languages: Basic Concepts, Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R Features, Reduction of an E-R Diagram to Tables.	7

Module 3 : Relational-Database Design: Functional Dependencies, Decomposition, Desirable Properties of Decomposition, First Normal Form, Second Normal Form, Third normal Form, Boyce-Codd Normal Form, Fourth Normal Form.	7
Module 4 : Query Processing and Optimization: Overview, Measures of Query Cost, Selection Operation, Transformation of Relational Expressions, Estimating Statistics of Expression Results, and Choice of Evaluation Plans.	7
Module 5 : Transactions and Concurrency Control: Transaction Concept, Transaction State, Desirable Properties of Transactions, Concurrent Executions, Recoverability, Lock-Based Protocols, and Deadlock Handling.	7

Text Books:

1. Silberschatz, Korth, &Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill.

Reference Books:

1. Elmasri, & Navathe, "Fundamentals of Database Systems, 5th Edition, Pearson Education, 2008.
2. Date C.J., "An Introduction to Database System", Pearson Education, New Delhi, 2005.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	2	2	1	1	2	1	1	2	2	3
CO2	3	3	3	2	1	2	2	1	1	2	1	1	2	2	3
CO3	2	2	2	1	1	2	1	1	1	1	1	1	2	2	3
CO4	1	2	1	3	1	1	1	2	2	1	2	2	2	2	3
CO5	3	3	3	1	2	1	1	1	2	2	2	2	1	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1,CO2,CO3,CO4	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1, CD9
CD3	Seminars	CO5	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO5	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1, CD2
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self- learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Simulation	CO5	

COURSE INFORMATION SHEET

Course Code	:	SC25205
Course Title	:	Mathematics for Artificial Intelligence
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS)
Semester/Level	:	III/2
Branch	:	AI & DS

Course Objectives: This course enables the students to:

A.	Construct logical statements for validation
B.	Work with data in form of matrices and respective analysis.
C.	Design and solve problems of relation in elements among sets.
D.	Use Graphs for different analysis.
E.	Solve problems of optimization.

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

CO1	Understand the concepts of binary logic in validation of arguments.
CO2	Understand matrices and its uses for applications.
CO3	Understand the idea of building relations among elements and its analysis.
CO4	Understand Graphs and related matrices for detecting properties in Graphs.
CO5	Understand concept of optimization in two or more variables.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Logic- Bivalent logic, Statements, Operations (Conjunction, disjunction, negation, conditional, biconditional statements) and Properties, Tautologies, Arguments and Validation of Arguments, Mathematical Induction, Proof by Contradiction, Proof by Cases, Contrapositive statement.	**7**
Module-2: Matrices -Vectors, Linear dependence and independence of vectors, Rank of Matrices, Eigen values and Eigen Vectors of a Matrix, Orthogonal Matrices, Singular value Decomposition of Matrices.	**7**
Module-3: Sets and Relation - Cartesian Product of Sets, Relation on a Set, Properties of Relation, Equivalence relation, Partial ordered relation, Effect of relation on the set, Partition due to equivalence relation, Hasse Diagram, Matrices of relation and their operations, Closure.	**7**
Module-4: Graphs - Graphs, Simple Graphs, Directed Graphs, Degree of vertex and its properties, Trees, Graphs and Matrices, Adjacency matrix, Power of Adjacency matrix (A^k) and its application in Ranking, Gramian Matrix.	**7**

Module-5: Optimization - Maximization and minimization in Single variable, Partial differentiation, Maximization and minimization in Two variables, Lagrange's method of Undermined multiplier. Gradient and Hessian Matrix.	**7**

Text Books:

1. Kolman, B; Busby R.; Sharon R., "Discrete Mathematical Structures, 6TH edition", Pearson.
2. Arangala Crista, "Linear Algebra with machine learning and Data", CRC press.
3. B.S. Garewal, "Higher Engineering Mathematics", Khanna Publication.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design9

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	2	1	3	1	1	1	2	2	2	1	3	2	2	2
CO2	2	2	1	3	1	1	1	2	2	2	1	3	2	2	2
CO3	2	2	1	2	1	1	1	2	2	2	1	3	2	2	2
CO4	2	2	1	2	1	1	1	2	2	2	1	3	1	1	1
CO5	2	2	1	1	1	1	1	2	2	2	1	3	1	1	1

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25207
Course Title : Fundamentals of Logic Design and Computer Architecture
Pre-requisite(s) :
Co-requisite(s) :
Credits : 3 L: 3 T: 0 P: 0
Class schedule/ week : 3
Class : B.Sc. (AI & ML)
Semester/Level : III/2
Branch : AI & ML

Course Objectives: This course enables the students to:

A.	Understand and apply digital logic fundamentals.
B.	Design and optimize combinational and sequential circuits.
C.	Comprehend CPU and memory organization principles.
D.	Analyze performance and design issues in computer architecture.
E.	Implement basic hardware-level designs related to computing systems.

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

CO1	Understand and apply digital fundamentals including number systems, Boolean algebra, and logic gates.
CO2	Design and analyze combinational logic circuits using systematic methods.
CO3	Implement sequential logic circuits including flip-flops, counters, and state machines.
CO4	Comprehend basic computer organization and instruction processing.
CO5	Analyze memory hierarchy, cache systems, and I/O organization for computer performance.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Digital Systems & Boolean Algebra: Number systems: Binary, Octal, Decimal, Hexadecimal, Boolean algebra principles and theorems, Logic gates and truth tables, Codes: BCD, Gray Code, ASCII, error detection and correction, Boolean function simplification and representation	8
Module 2: Combinational Logic Design: Karnaugh maps (up to 4 variables) and Quine-McCluskey method, Design of arithmetic circuits: Adders, subtractors, multipliers, Multiplexers, decoders, encoders, comparators, Circuit minimization techniques.	7

Module 3: Sequential Logic Design: Flip-flops: SR, JK, D, T; Latches, Counters: Synchronous, asynchronous, ring, Johnson, Registers: Shift registers, universal registers, State machine design: Mealy and Moore models	7
Module 4: Computer Organization: Von Neumann and Harvard architecture, CPU structure: Registers, ALU, control unit, Instruction formats and addressing modes, Control unit design: Hardwired and microprogrammed, Basic pipelining concepts.	6
Module 5: Memory & I/O Organization: Memory hierarchy: Registers, cache, main memory, secondary memory, Memory addressing, interfacing, Virtual memory concepts and page replacement algorithms, I/O organization: Interrupts, DMA, bus systems	7

Text Books:
1. M. Morris Mano, Digital Design, 6th Edition
2. M. Morris Mano, Computer System Architecture, 3rd Edition

Reference Books:
1. William Stallings, Computer Organization and Architecture, 11th Edition

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1	2	1	2	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	1	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	3	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	2	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/ Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/ Projects	CO4	CO4CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self-learning, such as the use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25209
Course Title : Complex Variables and Linear Algebra
Pre-requisite(s) :
Co-requisite(s) :
Credits : 3
Class schedule/ week : L: 3 T: 0 P: 0
Class : B.Sc. (CS)
Semester/Level : III/2
Branch : CS

Course Objectives : This course enables the students to:

A.	Provide the basic understandings of Vector.
B.	Impart the knowledge of Vector Spaces and its applications.
C.	Understand the Orthogonal Spaces.
D.	Enable the students to understand Complex Functions and Operations on Complex Functions, differentiation and Integration.
E.	Enable the students to apply these concepts to solve real world problem.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Solve the problems associated with vector space.
CO2	Implement the linear transformation of the vector spaces.
CO3	Apply the Orthogonalization Process to obtain orthonormal Vectors.
CO4	Understand Complex Functions and the operations on the Complex Functions.
CO5	Apply the various integration theorems of the Complex Functions in the calculation of geometric shapes.

SYLLABUS

MODULE	NO. OF HOURS
Module 1 : Vector Space: Binary Operations, Algebraic Structures, Vector Space, Subspace, Linear Span, Linear Dependence, Linear Independence, Dimension and Basis of a Vector Space.	**7**
Module 2 : Linear Transformation: Definition and Example of Linear Transformation, Rank and Nullity of Linear Transformation, Inverse of a Linear Transformation, Rank-Nullity Theorem, Sum of Linear Transforms, Scalar Multiple of Linear Transforms, Composition of Linear Transforms, Operator Equations.	**7**

Module 3 : Inner Product Space: Definition and Concept of Inner Product Space, Schwarz's Inequality, Orthogonal Vectors, Vector Projection, Orthogonal Basis of Inner Product Space, Orthonormal Set of Vectors, Gram-Schmidt Orthogonalization,	**7**
Module 4 : Complex Numbers and Functions: Introduction to Complex Numbers, Operations on Complex Numbers, Complex Functions, Continuity of Complex Functions, Analytic Functions, L'Hospital's Rule, Differentiation of Analytic Functions, Elementary Complex Functions, Mappings by Functions.	**7**
Modue 5 : Complex Integration: Definition and Concept, Independence of Path, Applications of Green's Theorem, Applications of Cauchy-Goursat Theorem, Applications of Deformation Theorem, Cauchy Integral Formula.	**7**

Text Books:

1. R. P. Agarwal, K. Perera, S. Pinelas, An Introduction to Complex Analysis, Springer.
2. V. Krishnamurthy, V. P. Mainra, J. L. Arora, An Introduction to Linear Algebra, East-West Press Pvt. Ltd.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.
2. B. S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.
3. A. R. Vasishtha, Modern Algebra, Krishna Prakashan Mandir.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	3	2	3	3	2	2	2	1	1	1	2	1	3	2
CO2	3	3	1	3	2	1	3	1	1	1	1	2	2	3	1
CO3	3	2	3	2	3	2	2	3	1	1	2	1	2	2	3
CO4	3	1	3	2	1	1	2	2	1	2	1	1	2	3	2
CO5	2	2	3	1	3	3	1	2	2	1	1	2	2	1	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25202
Course Title : Data Analytics Lab
Pre-requisite(s) :
Co-requisite(s) : Data Analytics and Visualization
Credits : 1.5
Class schedule/ week : L: 0 T: 0 P:3
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : III/2
Branch : AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Know details of programming concepts (using Python, R etc.)
B.	Understand Applications, advantages and limitations of various data types.
C.	Understand real life use of data analytics.
D.	Implement projects on data analytics using any Language like Python, R etc.
E.	Use tools to develop applications

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand basic concepts of programming.
CO2	Classify features of programming and skills for various data analytic tool.
CO3	Apply the knowledge gained for their project work as well as to develop some statistical applications.
CO4	Apply various statistical techniques for data analysis and hypothesis testing.
CO5	Apply various statistical techniques for data analysis and hypothesis testing.

SYLLABUS

Module 1: . Data Exploration and Descriptive Statistics: a. Program on data reading and writing using csv file. b. Load a dataset of your choice and perform initial exploratory data analysis. c. Calculate descriptive statistics (mean, median, standard deviation) for a specific variable in the dataset. d. Visualize the distribution of a numerical variable using a histogram or box plot.
Module 2: Data Cleaning and Preprocessing: a. Handle missing values in a dataset using appropriate techniques (e.g., imputation, deletion). b. Identify and handle outliers in a dataset using visualization and statistical methods. c. Perform data normalization or standardization on a numerical variable.
Module 3: . Hypothesis Testing: a. Formulate a null and alternative hypothesis for a given research question. b. Conduct a t-test to compare the means of two independent groups. c. Perform a chi-square test of independence to assess the relationship between two categorical variables.

Regression Analysis: a. Build a simple linear regression model to analyze the relationship between two variables. b. Interpret the coefficients and significance levels in a multiple linear regression model.
Module - 4: . Hypothesis Testing with Categorical Variables: a. Conduct a chi-square test of independence to determine if there is a relationship between two categorical variables. b. Calculate the odds ratio and interpret its significance in logistic regression.
Module – 5 : Model Evaluation and Selection: a. Split a dataset into training and testing sets and evaluate the performance of a predictive model. b. Compare different machine learning models (e.g., decision tree, random forest) and select the best performing one based on evaluation metrics.

TEXT BOOKS:

1. R for Everyone: Advanced Analytics and Graphics, Book by Jared P. Lander
2. "Exploratory Data Analysis" by John W. Tukey
3. "R Graphics Cookbook" by Winston Chang

REFERENCE BOOKS:

1. "Storytelling with Data" by Cole Nussbaumer Knaflic
2. "Data Visualization: A Practical Introduction" by Kieran Healy

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	CD1 Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD5, CD8,CD2
CD3	Seminars	CO3	CD1, CD5, CD5,CD2
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD3, CD4, CD6, CD7, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25204
Course Title : Database Design Lab
Pre-requisite(s) :
Co-requisite(s) : Database Design Concepts
Credits : 1.5
Class schedule/ week : L: 0 T: 0 P: 3
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : III/2
Branch : AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Understand the purpose, architecture, models, and languages of database systems.
B.	Analyze entity–relationship models, relational data models, and their constraints for effective database design.
C.	Apply normalization techniques and functional dependency concepts for relational database schema refinement.
D.	Evaluate query processing strategies, cost measures, and optimization techniques for efficient query execution.
E.	Demonstrate concurrency control, transaction management, and recovery mechanisms in multi-user environments.

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

CO1	Explain the purpose, architecture, components, and users of database systems, including transaction management.
CO2	Develop ER diagrams, identify keys, apply constraints, and transform conceptual designs into relational schemas.
CO3	Apply normalization (1NF, 2NF, 3NF, BCNF, 4NF) and functional dependency concepts to achieve an optimized database design.
CO4	Analyze query evaluation strategies, estimate query costs, and compare optimization techniques for efficient query processing.
CO5	Implement transaction management and concurrency control mechanisms to ensure consistency, isolation, and recoverability in databases.

SYLLABUS

Module - 1: Introduction to Database Systems
Objective: Purpose of DB, Data Models, SQL basics.

Lab Exercises:

University Database

- STUDENT(Student_ID PK, Name, Dept, Semester, DOB, Gender, Phone)
- COURSE(Course_ID PK, Course_Name, Credits, Dept)
- FACULTY(Faculty_ID PK, Name, Dept, Phone)
- ENROLLMENT(Enroll_ID PK, Student_ID FK, Course_ID FK, Grade)
- TEACHES(Teach_ID PK, Faculty_ID FK, Course_ID FK, Semester)
- FEES(Fee_ID PK, Student_ID FK, Amount, Status)

1. Create the STUDENT, COURSE, FACULTY, ENROLLMENT, TEACHES, FEES tables.
2. Insert at least 10 sample records in each table.
3. Write queries using comparison operators (>, <, !=).
4. Write queries using logical operators (AND, OR, NOT).
5. Use aggregate functions (COUNT, SUM, AVG, MIN, MAX).
6. Group results using GROUP BY and filter using HAVING.
7. Demonstrate LIKE and pattern matching queries (%, _).

Module - 2: Relational Data Models and Languages
Objective: ER Modelling, Constraints, Keys, E-R to Tables

Lab Exercises:

1. Draw ER diagram for the University Database.
   - Identify strong and weak entities in the ER model.
   - Implement entity constraints: Primary Key, Unique, Not Null, Default Values
2. Implement referential integrity using ON DELETE CASCADE and ON UPDATE CASCADE.
3. Insert data violating constraints and check DBMS response.
4. Write SQL queries to:
5. Find all students enrolled in a course.
6. List courses taught by a specific faculty member.
7. Use ALTER TABLE to add a new attribute (Email) in STUDENT.
8. Drop a column (Phone) from FACULTY using ALTER TABLE.
9. Rename a table (COURSE → COURSE_DETAIL) and revert back.

Module - 3: Relational Database Design
Objective: Normalization, Functional Dependencies, Schema Refinement

Lab Exercises:

1. Create an unnormalized ENROLLMENT table (with repeating course fields) and normalize step-by-step into 1NF → 2NF → 3NF → BCNF.
2. Demonstrate functional dependencies:
   - Example: Student_ID → Name, Dept.
   - Verify using SQL queries.
3. Create a relation with update anomalies and show how normalization resolves them.
4. Apply Fourth Normal Form (4NF) by eliminating multivalued dependencies.
5. Write queries on normalized tables:
   - List students with all their courses.
   - Find students who paid fees fully.
6. Compare performance of queries before and after normalization using EXPLAIN.
7. Design and implement a view to hide sensitive attributes (e.g., Phone numbers of students).

Module - 4: Query Processing and Optimization
Objective: Query execution, cost, transformations

Lab Exercises:

1. Write join queries:
   - Inner Join
   - Left Join
   - Right Join
   - Full Outer Join (if supported)
2. Write nested queries (subqueries inside WHERE or FROM).
3. Write correlated subqueries (e.g., find students with above-average grades).
4. Create indexes on Student_ID and Course_ID. Compare query performance with and without index.
5. Use EXPLAIN / ANALYZE to display query execution plan.
6. Rewrite a query using equivalent transformations (e.g., subquery → join).
7. Compare cost of two different join strategies (nested loop vs. hash join).
8. Write queries with set operators: UNION, INTERSECT, EXCEPT.
9. Create a materialized view (if supported) and compare with normal view.

10. Optimize a query by eliminating unnecessary joins and redundant subqueries.

Module - 5: Transactions and Concurrency Control
Objective: Transactions, Deadlock, Recovery
Lab Exercises:

1. Implement a banking transaction for transferring funds between two students' fee accounts.
2. Write concurrent transactions to show:
   - Lost update problem
   - Dirty read problem
   - Non-repeatable read problem
   - Phantom read problem
3. Experiment with isolation levels (READ UNCOMMITTED, READ COMMITTED, REPEATABLE READ, SERIALIZABLE).
4. Implement locking using SELECT … FOR UPDATE.
5. Demonstrate deadlock by creating circular wait conditions and observe DBMS behaviour.
6. Write SQL queries to detect if a deadlock occurred (DB-dependent).
7. Perform a rollback after a simulated system failure.
8. Test checkpoint and log-based recovery (theoretical + available DBMS features).
9. Create a savepoint inside a transaction and rollback to it.
10. Compare execution of the same query with different concurrency settings.

Text Books:

1. Silberschatz, Korth, &Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill.

Reference Books:

1. Elmasri, & Navathe, "Fundamentals of Database Systems, 5th Edition, Pearson Education, 2008.
2. Date C.J., "An Introduction to Database System", Pearson Education, New Delhi, 2005.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1, CD9
CD3	Seminars	CO5	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO5	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1, CD2
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self- learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD7, CD8

COURSE INFORMATION SHEET

Course Code : SC25211
Course Title : Artificial Intelligence and Applications
Pre-requisite(s) :
Co-requisite(s) :
Credits : 4
Class schedule/ week : L:3 T:1 P:0
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : IV / II
Branch : AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Define key artificial intelligence paradigms and differentiate between types of AI.
B.	Formulate real-world problems (e.g., search problems) and implement fundamental search algorithms.
C.	Explain reasoning processes using predicate logic.
D.	Understand probabilistic reasoning.
E.	Describe the architecture of neural networks and deep learning models.

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

CO1	Understand the fundamental types of artificial intelligence and the concepts of intelligent agents.
CO2	Apply various search techniques to solve real-world problems.
CO3	Represent knowledge using predicate logic and apply the resolution process for reasoning.
CO4	Explain the concepts of reasoning under uncertainty.
CO5	Understand the core concepts of artificial neural networks and deep learning.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Introduction: Overview of Artificial Intelligence, Types of AI, Applications of AI, Agent and Environment, Different types of Agents, Problem Space & Search, Control Strategies, Problem Characteristics.	8
Module – 2 : Searching Techniques: Solving Problems by Searching, Problem Solving Agents, Uninformed Searching Strategies: BFS, DFS, Hill Climbing Search, Simulated Annealing Search, Informed Searching Strategies: Best First Search, A* Search.	8
Module – 3 : Using Logic: Propositional Logic, Representing Simple Facts in Predicate Logic, Conversion to Clausal Form, Resolution.	8
Module – 4 : Probabilistic Reasoning: Representing Domain in an Uncertain Domain, Monotonic System vs Non-monotonic System, Truth Maintenance System, Default Reasoning and the Closed World Assumption, Bayesian Belief Networks.	8
Module – 5 : Artificial Neural Networks: What is a Neural Network? Models of Neuron, Artificial Neural Network Architecture, Convolution Neural Networks, Deep Learning.	8

Textbooks:

1. Artificial Intelligence: A Modern Approach. Russel and Norvig. Pearson India Education, 2021.
2. Rich E. & Knight K., "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill Publishing Company Limited, 2008.

Reference Books:

1. Artificial Intelligence, Saroj Kaushik, Cengage Learning India Private Ltd., 2018.
2. Neural Networks and Deep Learning: A Textbook. Charu C. Aggarwal. Springer, 2018.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	1	2	2	1	1	2	2	1	2	2	3	2	2
CO2	3	2	2	1	3	1	1	1	2	1	2	2	3	2	3
CO3	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3
CO4	3	2	3	2	3	1	2	2	3	2	2	2	3	2	3
CO5	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4, CD5, CD6, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD4, CD5, CD6, CD8
CD3	Seminars	CO3	CD1, CD2, CD4, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD4, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25217
Course Title : Computer Networks
Pre-requisite(s) : Fundamentals of Computers
Co-requisite(s) :
Credits : 3
Class schedule/ week : L: 3 T: 0 P:0
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : IV/2
Branch : AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Have a broad understanding of computer network models, software and hardware.
B.	Learn different transmission mediums, digital and analog signals and their transmission techniques.
C.	Explore error detection and correction techniques, data link protocols and standards
D.	Understand network layer and transport layer protocols.
E.	Implement and analyze routing and congestion issues in network design, Familiarize with network security, DNS, email and encryption algorithms.

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

CO1	Understand basic concepts of networks, network hardware and network software and describe various standard network models
CO2	Understand data communication, various transmission media and familiarize with digital transmission and multiplexing techniques.
CO3	Analyze error detection and correction, data link protocols, understand the role of data link layer protocols.
CO4	Implement and analyze routing and congestion issues in network design.
CO5	Familiarize with network security, DNS and network management algorithms.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 : Introduction: Uses of Computer Networks, Needs and Advantages, Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless networks. Network Topology: Star, Bus, Ring, Tree, Mesh and Hybrid. Network Software: Protocol Hierarchies, Design Issues for the Layers, Interfaces and services, Connection-Oriented Versus Connectionless Service. Reference Models: The OSI Reference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models.	7

Module 2 : Physical Layer: Transmission Media: Guided transmission media, wireless transmission, Communication satellites. Multiplexing: TDM, FDM. Analog and Digital Signals: Characteristics and their transmission. Transmission impairment.	7
Module 3 : Services Provided to the Network Layer: Framing, Error Control, Flow Control. Error Detection and Correction: Error-Correcting Codes, Error-Detecting Codes. Elementary Data Link Protocols: Simplest, Stop-and-wait, Stop-and-wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ. HDLC Protocol.	7
Module 4 : Network Layer: Logical Addressing: IPv4 addresses, IPv6 addresses. Need for network layer. Internet Protocol: IPv4, IPv6. Routing Algorithms: Unicast and Multicast routing Protocols. **Transport Layer:** Protocols: UDP, TCP. Congestion control.	7
Module 5 : Application Layer: Domain Name System: Name Space, Distribution, DNS in the Internet, Resolution. Network Security: Cryptography: Introduction, Symmetric, Asymmetric. Security Services. Digital Signature	7

Text Books:

1. Forouzan, B., "Data Communication and Networking", TMH.
2. Andrew S Tanenbaum– ― Computer Networks‖ – PHI.

Reference Books:

1. William Stallings – ― Data and Computer Communications‖ – Pearson Education Asia, Seventh Edition,2001
2. Douglas E Comer - ―Computer Networks and Internets‖, -Pearson Education, 2014.
3. Larry L. Peterson, Bruce S Davie – ―Computer Networks: A Systems Approach‖, Fourth Edition,2007 (The Morgan Kaufmann Series in Networking

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus
Topics beyond the syllabus/ Advanced topics/ Design
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	2	2	1	1			2	2	3	3	3	3
CO2	3	2	2	2	2	1	1		2	2	2	3	3	3	3
CO3	3	3	2	2	2	2	1		2	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD6, CD7
CD3	Seminars	CO3	CD1, CD2, CD3, CD6,
CD4	Mini Projects/Projects	CO4	CD1, CD3, CD6, CD7
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD4, CD5, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25213
Course Title	:	Data Mining and Applications
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3 L: 3 T: 0 P: 0
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	IV/2
Branch	:	AI&DS/AI&ML/CS

Course Objectives: This course enables the students to:

A.	Understand the need of data mining activities.
B.	Identify the methods of pre-processing data and performing activates related to ETL.
C.	Know the various applications of data mining
D.	Familiarize the concepts of Data mining
E.	Decide what data mining activities are required to obtain the desired objectives.

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

CO1	Identify data mining related applications and activities.
CO2	Assess the problem and decide what data mining activities are required to obtain the desired objectives.
CO3	Mathematically perform pre-processing operations on datasets to ensure the validity of the data improved.
CO4	Analyse and evaluate algorithms for performing common data mining.
CO5	Apply Data mining methods for performance and optimization issues.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1: Fundamentals of data mining, Data mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Database & Datawarehouse System, Major issue in datamining. Tools of data mining. Data Preprocessing: Need of data Preprocessing, Data Cleaning, Data Integration, Data Transformation, Data Reduction, Discretization, Concept Hierarchy Generation.	7
Module – 2: Data Warehouse, Multidimensional data model, Characteristics of data warehouse, Data Warehouse Architecture, OLAP, Types of OLAP: ROLAP, MOLAP, HOLAP. Development of data cube and computation. Data Warehouse Schema: Star Schema, Fact Constellation, Snowflake Schema and Measure: different types of measures, Data Warehouse Operation: Rollup, Drill Drown, Slice, Dice.	7
Module – 3: Association Analysis: Basic Concepts Association Rule, Support & Confidence, Frequent Itemset Generation. The Apriori Principle. Frequent Itemset Generation using Apriori Algorithm	7

Module – 4: Classification: Basic Concepts and Techniques. General Framework for Classification. Decision Tree Classifier. A Basic Algorithm to Build a Decision Tree. Methods for Expressing Attribute Test Conditions. Algorithm for Decision Tree Induction. Characteristics of Decision Tree Classifiers.	7
Module – 5: Cluster Analysis: Basic Concepts and Algorithms. What is Cluster Analysis? Different Types of Clustering. Different Types of Clusters. K-means. Basic K-means Algorithm. Basic Agglomerative Hierarchical Clustering Algorithm. Key Issues in Hierarchical Clustering, Density based clustering.	7

Text Books:

1. Tan Pang-Ning, Steinbach Michael, and Kumar Vipin , "Introduction to Data Mining", Pearson Education, New Delhi.
2. W. H. Inmon, Building the Data warehouse, 3rdEdn, Wiley Dreamtech India (P) Ltd., 2003.

Reference Books:

1. Han Jiawei & Kamber Micheline, "Data Mining Concepts & Techniques", Publisher Harcourt India Private Limited, Second Edition
2. Dunham H.M. & Sridhar S., "Data Mining", Pearson Education, New Delhi

Gaps in the Syllabus (to meet Industry/ Profession requirements)

1. Interaction with domain knowledge concepts with the actual algorithmic implementation.
2. Handling various data using same data mining algorithms.

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
1.Text Mining
2.Outlier Mining
3. Advanced clustering algorithms

POs met through Topics beyond the syllabus/ Advanced Topics/ Design
1, 2, 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	2	1	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials / Assignments	CO2	CD1, CD8 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD5
CD4	Mini Projects	CO4	CD1, CD5, CD8, CD98
CD5	Laboratory Experiments/ Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial / Guest Lectures		
CD7	Industrials Visits / In -Plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulations		

COURSE INFORMATION SHEET

Course Code : SC25215
Course Title : Fundamentals of Computer Algorithms
Pre-requisite(s) : Introduction to Data Structures
Co-requisite(s) :
Credits : 4 L: 3 T: 1 P: 0
Class schedule/ week : 4
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : IV/2
Branch : AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand basic algorithm designing techniques such as recursion, greedy, dynamic programming and backtracking.
B.	Analyze the asymptotic performance of an algorithm.
C.	Demonstrate a familiarity with algorithms and data structures.
D.	Apply important algorithmic design paradigms and methods of analysis in solving real life problems.
E.	Synthesize efficient algorithms in common engineering design situations.

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

CO1	Have a clear understanding on solving the problems systematically.
CO2	Make use of linear and non-linear data structures, like, graphs and trees while designing algorithms.
CO3	Have a clear understanding of different design paradigms
CO4	Analyze and measure the efficiency of an algorithm.
CO5	Demonstrate the basic knowledge of fundamentals of algorithms which would help them to take up an advanced course in the same field.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1: Introduction: Algorithm and Pseudocode, Time & Space complexity, best, worst, average cases Asymptotic Notations: Big-O, Ω, Θ, little-o. Recurrence Relations & Solving Techniques: Substitution, Recurrence Trees, Master Theorem	8
Module – 2: Recursion: Basic concept, Analysis of recursive algorithm Divide & Conquer: The general method, Binary Search, merge sort, quicksort, insertion sort, best- and worst-case analysis, Strassen's Matrix multiplication.	8
Module – 3: The Greedy Method: General characteristics of greedy algorithms, Problem solving using greedy methodology: Fractional Knapsack problem, Minimum Spanning trees (Kruskal's algorithm, Prim's Algorithm), single source shortest path problem (Dijkstra's algorithm)	8

Module – 4: Dynamic Programming: The general method, principles of dynamic programming: memorization or iterations over sub problems, all-pairs shortest path problem, 0/1 Knapsack problem. Backtracking: N-Queens, Subset-Sum problem	8
Module – 5: NP Completeness and Other related Topics: NP Completeness and the classes P and NP, Overview of showing problems to be NP-Complete, (Decision and Optimization problems, Reductions), NP-Hard problems, NP Completeness proofs (Max-Clique, Vertex Cover), Introduction to Approximation Algorithms	8

Text Books:

1. Jon Kleinberg and Eva Tardos. Algorithm Design. Pearson Education (Latest Edition).
2. Sahni Sartaj. Computer Algorithms. Computer Science Press (Latest Edition)

Reference Books:

1. T. H. Cormen. Introduction to Algorithms. 3Ed. (International Edition) (MIT press)
2. Anany Levitin. Introduction to The Design and Analysis of Algorithms. Pearson Education (3rd Edition).

Gapsinthe Syllabus (to meet Industry/Profession requirements) NA

POs met through Gaps in the Syllabus: NA
Topics beyond the syllabus/Advanced topics/Design: NA
POs met through Topics beyond the syllabus/ Advanced Topics/ Design NA

Course Outcome(CO)Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**%Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	1	3	2	3	1	2	2	3	1	1	2	2	2
CO2	3	2	1	2	3	2	1	2	3	2	1	1	3	2	2
CO3	2	3	3	2	2	2	2	3	1	2	3	2	2	3	2
CO4	2	3	2	1	2	2	3	2	1	2	3	2	1	2	3
CO5	2	3	2	2	2	2	2	1	2	3	2	1	2	3	1

CorrelationLevels1,2or3asdefined below:
1:Slight(Low)2:Moderate(Medium)3:Substantial(High)

Mapping between Cos and Course Delivery(CD)methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lectures by use of board(s) / LCD Projector(s),	CO1	CD1, CD2
CD2	Tutorials/ Assignments	CO2	CD1, CD2, CD8
CD3	Seminars	CO3	CD2, CD6, CD8
CD4	Mini Projects	CO4	CD1, CD2, CD8
CD5	Laboratory Experiments	CO5	CD1, CD3, CD6, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visit/In-plant Training		
CD8	Self-learning use of NPTEL Materials		

COURSE INFORMATION SHEET

Course Code : SC25221
Course Title : Data Science Concepts
Pre-requisite(s) :
Co-requisite(s) :
Credits : 4
Class schedule/ week : L: 3 T: 1 P: 0
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : IV/2
Branch : AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Understand the fundamental concepts of data science.
B.	Understand the concept of Exploratory Data Analysis
C.	Understand basics of Statistical methods
D.	Know about the different tools and techniques used in data science
E.	Understand about inferential statistics and model evaluation.

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

CO1	Demonstrate key concepts related to Data Science.
CO2	Apply data pre-processing techniques.
CO3	Able to do exploratory data analysis on datasets.
CO4	Apply regression techniques.
CO5	Apply the inferential statistics.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Introduction: Definition, Data science in various fields, Facets of data, The data science process, The big data eco system and data science, An introductory working example of Hadoop.	8
Module 2: Understanding Data: Types of data – Numeric, Categorical, Ordinal. Classification of data: Structured, Semi-structured and Unstructured. Sources of data: Time series, Transactional data, Spatial Data, Social Network data – Date evolution. Data Pre-processing: Overview, Data cleaning, Data Integration and Transformation. Data Reduction. Data Discretization	8
Module 3: Exploratory Data Analytics: Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics – ANOVA.	8

Module 4 : Model development: Regression models: Simple linear regression, least-squares principle, MLR, Multiple regression, Multiple correlation, Partial correlation, Model Evaluation using Visualization.	8
Module 5 : Statistical Inference: Developing Initial Hypotheses, Identifying Potential Data Sources, Testing hypotheses on means, proportions and variances. Model Evaluation: Cross-validation, Underfitting and Overfitting, Model selection.	8

Text Books:

1. Davy Cielen, Arno D B Meysman, Mohamed Ali, "Introduction to Data Science", Dreamtech Press.
2. Gupta S.P. and Gupta M.P., Business Statistics, Sultan Chand & Sons.

Reference Books:

1. Hastie, Trevor, et al. "The elements of Statistical Learning", Springer.
2. Practical Statistics for Data Scientists, 2nd Edition, Peter Bruce, Andrew Bruce and Peter Gedeck.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	1	1	1	2	1	1	1	1	1	3	3	1	1
CO2	3	3	3	2	2	2	2	3	2	2	2	3	3	3	2
CO3	3	3	2	3	2	2	2	3	2	2	2	3	3	3	2
CO4	3	3	3	2	2	2	2	3	2	2	2	3	3	3	2
CO5	3	3	2	2	2	2	2	3	2	2	2	3	3	3	2

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD6, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25214
Course Title : Data Mining Lab
Pre-requisite(s) :
Co-requisite(s) :
Credits : 1.5 L: 0 T:0 P:3
Class schedule/ week : 3
Class : B.Sc. (AI & DS / AI & ML / CS)
Semester/Level : IV/2
Branch : AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Explain about the necessity of preprocessing and its procedure.
B.	Generate and evaluate Association patterns
C.	Solve problems using various Classifiers
D.	Learn the principles of Data mining techniques and various mining algorithms.
E.	Learn about traditional and modern data driven approach and problem-solving techniques for various datasets

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

CO1	Understand Data Warehousing and Data Mining and its applications and challenges and create mini data warehouse.
CO2	Apply the association rules for mining applications
CO3	Identify appropriate Classification techniques for various problems with high dimensional data.
CO4	Implement appropriate Clustering techniques for various problems with high dimensional data sets.
CO5	Implement various mining techniques on complex data objects.

SYLLABUS

List of Programs as Assignments:

Q1. Build a Data Warehouse and Explore WEKA tool.
Q2. Create your own EXCEL file. Convert the EXCEL file to .csv format and prepare it as .arff file. Try to create your own dataset.
Q3. Demonstration of preprocessing on datasets Weather.
Q4. Explore various options available in WEKA for preprocessing data and apply unsupervised filters like Discretization on any dataset like weather.
Q 5. Load weather, Iris datasets into WEKA and run Apriori algorithms with different support and confidence values.
Q6. Demonstration of Association rule process on dataset using apriori algorithm.
Q7. Demonstrate performance of classification on various data sets.
Q8. Demonstrate performance of clustering on various data sets.
Q9. Demonstrate performance of Regression on various data sets
Q10. Implement following algorithms for various datasets using K-means clustering.
Q11. Implement Bayesian Classification for various datasets
Q12 Implement Decision Tree for various datasets.
Q13. Implement Support Vector Machines.

Text Books :
1. Jiawei Han & Micheline Kamber - Data Mining Concepts & Techniques Publisher Harcout India. Private Limited.

Reference Books :
1. G.K. Gupta – Introduction to Data Mining with case Studies, PHI, New Delhi
2. A. Berson & S.J. Smith – Data Warehousing Data Mining, COLAP, TMH, New Delhi
3. H.M. Dunham & S. Sridhar – Data Mining, Pearson Education, New Delhi.

Course Evaluation:
Day to day progressive evaluation, Lab Quizzes, Surprise Tests, Online Lab performance and Viva Voce

Gaps in the syllabus (to meet Industry/Profession requirements):
Implementing of real-world problems

POs met through Gaps in the Syllabus: PO5 & PO6
Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design: Teaching through research papers.

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance & Lab files	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination /Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	3	2	2	2	1	2	3	3	3	3	3	1
CO2	2	3	2	3	2	2	1	2	2	3	3	3	2	2	2
CO3	2	3	3	3	3	3	3	2	3	3	3	3	2	2	3
CO4	3	2	2	3	3	2	2	1	3	3	3	3	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	3	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials / Assignments	CO2	CD1, CD8 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD5
CD4	Mini Projects	CO4	CD1, CD5 , CD8 , CD98
CD5	Laboratory Experiments/ Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial / Guest Lectures		
CD7	Industrials Visits / In -Plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulations		

COURSE INFORMATION SHEET

Course Code	:	SC25216
Course Title	:	Computer Algorithms Lab
Pre-requisite(s)	:	Data Structure & Algorithm
Co-requisite(s)	:	Data Structure Lab
Credits	:	1.5 L: 0 T: 0 P: 3
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	IV/2
Branch	:	AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Design algorithms and analyze its time complexity.
B.	Develop programs for searching and sorting based problems and analyze its time complexity
C.	Solve and analyze problems using dynamic programming.
D.	Solve and analyze problems using greedy based approach.
E.	Solve and analyze problems using backtracking approach.

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

CO1	Design algorithms for various computing problems.
CO2	Analyze the worst case running time of algorithms using asymptotic notations.
CO3	Implement various sorting and searching algorithms along with its time complexity analysis.
CO4	Analyze the different algorithmic approaches for various computing problems.
CO5	Analyze the optimization and approximation of algorithms.

SYLLABUS

1. Write programs to analyze time complexity of iterative and recursive algorithms.
2. Implement searching algorithms (Linear Search, Binary Search) along with its time complexity.
3. Implement various sorting algorithms like merge sort, insertion sort, quick sort and heap sort along with its time complexity analysis.
4. Implement Strassen's matrix multiplication.
5. Implement job sequencing with deadline approach.
6. Implement fractional knapsack problem.
7. Implement Single-Source Shortest Path problem.
8. Implement 0/1 Knapsack Problem.
9. Implement N-Queens problem.
10. Implement Sum of Subset problem.

Text Books:

1. Fundamentals of Algorithmics by Gilles Brassard and Paul Bratley Pearson, Latest Edition
2. Fundamentals of Computer Algorithms by Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran Orient BlackSwan, Second / Latest Edition

Reference Books:

1. T. H. Cormen. Introduction to Algorithms. 3Ed. (International Edition) (MIT press)

Gaps in the Syllabus (to meet Industry/ Profession requirements) NA

POs met through Gaps in the Syllabus: NA
Topics beyond the syllabus/ Advanced topics/ Design: NA
POs met through Topics beyond the syllabus/ Advanced topics/ Design NA

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	2	3	3	1	2	3	3	3	2	3	3	2	1	3
CO2	2	2	2	3	2	1	1	1	2	3	2	2	3	2	3
CO3	2	3	3	2	1	1	1	3	1	1	1	2	2	2	3
CO4	2	2	3	3	2	1	2	2	2	3	3	3	3	3	3
CO5	2	1	3	2	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lectures by use of board(s) / LCD Projector(s),	CO1	CD1, CD2
CD2	Tutorials/ Assignments	CO2	CD1, CD2, CD8
CD3	Seminars	CO3	CD2, CD6, CD8
CD4	Mini Projects	CO4	CD1, CD2, CD8
CD5	Laboratory Experiments	CO5	CD1, CD3, CD6, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visit/In-plant Training		
CD8	Self-learning use of NPTEL Materials		

Course Information Sheet

Course Code	:	**SC25219**
Course Title	:	**Fuzzy Logic and Applications**
Pre-requisite(s)	:	Basics of Mathematics, Probability & Set Theory
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	IV/2
Branch	:	AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Understand fundamental concepts of fuzzy set theory and fuzzy logic.
B.	Develop skills to design and analyze fuzzy inference systems.
C.	Apply fuzzy logic techniques to solve real-world problems.
D.	Learn about the fuzzification of scalar variables and the defuzzification of membership functions
E.	Learn different fuzzy classification methods.

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

CO1	Explain basic fuzzy set theory, fuzzy relations, and fuzzy logic principles.
CO2	Design fuzzy inference systems and membership functions.
CO3	Implement fuzzy control systems and decision-making processes
CO4	Analyze applications of fuzzy logic in expert systems.
CO5	Gain the knowledge about fuzzy C-Means clustering.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 Crisp Set Theory: Introduction, Relations between sets, Operations on sets, Characteristic Functions, Cartesian Products of Crisp sets, Crisp Relations on sets. **Fuzzy Set Theory:** Introduction, Concept of a Fuzzy Set, Relation between Fuzzy sets, Operations on Fuzzy sets, Properties of the standard operations, Certain Number Associated with a Fuzzy set, Certain Crisp sets Associated with a Fuzzy set, Extension Principle.	**7**
Module 2: **Propositional Logic:** Introduction, Syntax of PL(1), Semantics of PL(1), Certain semantic properties, Certain Properties satisfied by the connectives, Inference Rules, Derivation, Resolution. **Predicate Logic:** Introduction syntax of PL(2), semantics of PL(2), Semantic Properties, Certain Properties Satisfied by the connectives and Quantifiers, Derivations, Resolution in PL(2).	**7**
Module 3: **Fuzzy Relations:** Introduction, Fuzzy Relations Operations on Fuzzy Relations. α-cuts of a Fuzzy Relation, Composition of Fuzzy Relations, Projections of Fuzzy Relations, Cylindric Extensions, Cylindric Closure, Fuzzy Relation on a Domain.	**7**

Module 4: Fuzzy Logic: Introduction, Three-valued Logic, N-valued Logic for N>= 4, Infinite-valued Logics, Fuzzy Logics, Fuzzy Propositions and Their Interpretations in Terms of Fuzzy sets, Fuzzy Rules and Their Interpretations in Terms of Fuzzy Relations. Fuzzy Inference or Approximate Reasoning, Generalizations of Fuzzy Logics	**7**
Module 5: Fuzzy Classification: Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition	**7**

Text Books:

1. **Timothy J. Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010.**
2. **George J. KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995**
3. **M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2004.**

Reference Books:

1. **S. Rajasekaran, G.A. Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003.**

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:

Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	1	1	1	1	1	1	1	1	1	2	3	2	1
CO2	3	3	2	2	2	1	1	1	1	1	1	2	3	3	2
CO3	2	3	3	2	3	1	1	1	2	2	2	2	2	3	3
CO4	2	2	3	2	2	1	2	1	2	3	2	3	2	2	3
CO5	3	3	3	2	3	1	1	1	1	2	2	3	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture-based teaching	CO1, CO2	Black/white board teaching, PPTs
CD2	Tutorials/Problem-solving sessions	CO1, CO2, CO3	Practice exercises, step-by-step derivations
CD3	Online Learning Resources (MOOCs, research papers)	CO4, CO5	NPTEL/YouTube resources, IEEE papers
CD4	Case Studies and Examples	CO3, CO4	Real-world fuzzy logic applications
CD5	Laboratory/Practical Sessions (using MATLAB/Python toolboxes)	CO3, CO5	Hands-on implementation of fuzzy inference systems, Fuzzy C-Means clustering
CD6			
CD7			
CD8			
CD9			

III YEAR

COURSE INFORMATION SHEET

Course Code	:	SC25301
Course Title	:	Software Engineering
Pre-requisite(s)	:	Problem-solving skills, and basic mathematics.
Co-requisite(s)	:	Machine Learning basics and Discrete Mathematics.
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P:0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand and apply software engineering principles in the design and development of AI/ML-based systems.
B.	Analyze user requirements and translate them into effective software specifications for intelligent applications.
C.	Apply software development life cycle (SDLC) models, agile methods, and best practices in AI/ML projects.
D.	Integrate databases, libraries, and frameworks for building scalable and reliable AI/ML solutions.
E.	Ensure software quality through testing, validation, documentation, and ethical considerations in AI/ML systems.

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

CO1	Apply software engineering concepts to design and implement AI/ML-based applications.
CO2	Identify, analyze, and model user requirements for intelligent software systems.
CO3	Demonstrate the use of SDLC models, agile practices, and project management techniques in AI/ML projects.
CO4	Develop scalable and reliable AI/ML applications by integrating suitable tools, libraries, and frameworks.
CO5	Evaluate AI/ML software solutions for correctness, performance, quality, and ethical compliance.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Software engineering principles and their relevance to AI/ML systems, Process models: Waterfall, Spiral, Agile, DevOps, and AI-specific life cycles, Introduction to MLOps: bridging ML model lifecycle with Software Engineering.	**7**
Module 2: Requirement elicitation, specification, validation, Functional and non-functional requirements, UML, and domain-driven design for ML pipelines, Data-centric AI requirements.	**7**
Module 3: Principles of modularity, abstraction, cohesion, and coupling, Software design patterns relevant to AI/ML systems, Data flow design, Interface design, APIs, integration of ML models with applications.	**7**
Module 4: Coding standards, version control, Testing: unit, integration, system testing; ML-specific testing (model validation, robustness testing), Deployment.	**7**

Module 5: Software quality assurance, Project estimation methods: Function Point, COCOMO, Latest trends: Responsible AI – fairness, transparency, explainability, ethics, sustainability in software systems.	**7**

Text Books:

1. Roger S. Pressman & Bruce Maxim – *Software Engineering: A Practitioner's Approach*, 9th Edition, McGraw-Hill, 2019.
2. Chip Huyen – Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications, O'Reilly, 2022.

Reference Books:

1. Ian Sommerville, *Software Engineering*, 10th Edition, Pearson, 2020.
2. Mark Treveil & Alok Shukla – "MLOps: Continuous Delivery and Automation Pipelines in Machine Learning," O'Reilly, 2020

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus: PO2, PO4, PO5
Topics beyond the syllabus/Advanced topics/Design: Teaching through research paper.
POs met through Topics beyond the syllabus/ Advanced Topics/ Design: Managing complex or open-ended projects with innovative approaches.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/ Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome:

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	1	2	1	2	3	3	1	1	1	3	2
CO2	2	3	1	2	2	2	2	2	2	3	2	1	1	2	3
CO3	2	3	3	3	3	1	1	1	2	3	1	2	2	3	3
CO4	3	1	2	1	2	1	2	2	1	1	1	2	2	3	2
CO5	2	2	1	2	3	1	1	1	1	3	2	3	1	2	3

Correlation Levels 1,2or 3as defined below:
1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD3
CD2	Assignments	CO2	CD1, CD2, CD3
CD3	Laboratory experiments/Teaching aids/Seminars	CO3	CD1, CD2, CD3
CD4	Demonstration / Case studies / Simulation	CO4	CD1, CD2, CD3
CD5	Project / Mini-project	CO5	CD1, CD2, CD3, CD4 CD5
CD6	Group discussion / Seminar / Peer learning		
CD7	Flipped classroom / Self-learning components		
CD8	Industry talk / Expert lecture / Webinar		
CD9	Online resources (MOOCs, coding platforms, GitHub, AI tools, etc.)		

COURSE INFORMATION SHEET

Course Code	:	SC25303
Course Title	:	Basics of Machine Learning
Pre-requisite(s)	:	
Co-requisite(s)	:	Machine Learning Lab
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P:0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Introduce the basic concepts and techniques of Machine Learning.
B.	Familiarize the concepts of regression models.
C.	Understand the concepts of feature selection and transformation techniques.
D.	Learn the utility of classification and clustering techniques.
E.	Identify machine learning algorithms for real-world problems.

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

CO1	Understand the basic concepts required for machine learning.
CO2	Apply regression models for prediction.
CO3	Identification of discriminating features for better learning and apply classification algorithm.
CO4	Evaluate and analyse the performance of a machine learning algorithm or a system based on machine learning algorithm.
CO5	Apply artificial neural network for the real-world data.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: **Introduction:** Machine Learning, Types of Machine Learning: Supervised, semi-supervised and unsupervised learning. Basics of Linear Algebra - matrices and vectors, Eigen value decomposition.	**7**
Module 2: **Supervised Learning:** Linear Regression: Prediction using Linear Regression, Linear Regression with one variable, Linear Regression with multiple variables. Logistic Regression: Classification using Logistic regression, Logistic regression vs. Linear regression, Logistic regression with one and multiple variables	**7**
Module 3: **Feature selection, Feature transformation:** Filter and Wrapper methods, Encoding schemes for data transformation, Principal component Analysis. **Classification:** Classification, Issues regarding classification, Techniques: Bayesian classification, Support Vector Machine, Decision Tree. Kernel trick	**7**
Module 4: **Unsupervised Learning**: Clustering: Introduction, Partitioning- K-Means, Hierarchical - agglomerative and Divisive clustering. **Model Assessment and Selection:** Bias, Variance and model complexity, Bias – variance tradeoff, Bayesian approach and BIC, Cross-validation, Performance of Classification Algorithms (Confusion Matrix, Precision, Recall and ROC Curve). **Regularization:** Regularization and its utility: the problem of Overfitting, Application of Regularization.	**7**

Module 5: **Artificial Neural Networks**: Introduction, Model Representation, Perceptron, Forward propagation, Backpropagation algorithm, regularization and bias/variance. Recurrent networks.	**7**

Text Books:

1. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India.
2. Mitchell Tom, "Machine Learning", Latest Edition, Mc-Graw Hill.

Reference Books:

1. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann.
2. Jiawei Han & Micheline Kamber "Data Mining Concepts & Techniques", Morgan Kauffman Publisher.
3. Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das, "Machine Learning", Pearson Education India.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/ Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	1	1	1	2	1	1	1	1	1	2	3	1	1
CO2	3	3	3	2	3	2	2	2	2	2	2	3	3	3	2
CO3	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2
CO4	2	3	2	3	3	2	1	1	2	2	1	3	3	3	2
CO5	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD5
CD3	Seminars	CO3	CD1, CD2, CD3, CD5, CD6, CD9
CD4	Mini Projects/ Projects	CO4	CD1, CD5, CD9
CD5	Laboratory Experiments/ Teaching Aids	CO5	CD1, CD2, CD3, CD6
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25305
Course Title	:	Deep Learning
Pre-requisite(s)	:	
Co-requisite(s)	:	Deep Learning Lab
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand the basic component of Machine Learning.
B.	Explore the application areas of Neural Networks.
C.	Understand the idea of Recurrent Neural Networks.
D.	Explore the basic concepts of Feed forward Neural Networks.
E.	Understand the concepts of Encoder.

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

CO1	Distinguish between machine learning and deep learning
CO2	Identify problems suitable for application of deep learning.
CO3	Explain the working of FF Neural Networks and their modifications.
CO4	Apply Convolutional & Recurrent Neural Networks to solve problems
CO5	Discuss the efficiency of deep learning systems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Machine Learning Basics: Learning Algorithms, Supervised and Unsupervised Learning algorithms, Capacity, Over Fitting and Under fitting, Estimators, Bias and variance, Maximum Likelihood Estimation, MAP, Bayesian Statistics	7
Module 2: Hebbian Learning, McCulloch Pitts Neuron, Activation functions, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), MLPs with Backpropagation	7
Module 3: Convolutional Neural Networks, Optimization Algorithms - Gradient Descent (GD), Momentum Based GD, Stochastic GD, Adam, Regularization- L1, L2 regularization, Early stopping, Dataset Augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Weight initialization methods, Batch Normalization	7

Module 4: Recurrent Neural Networks, Vanishing and Exploding Gradients, GRU, LSTMs, Backpropagation through time (BPTT)	7
Module 5: Encoder Decoder Models, Attention Mechanism, Attention over images, Introduction to GANs..	7

Text Books:

T1: Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville
T2: Generative Deep Learning, 2nd Edition, by David Foster, O'Reilly Media, Inc.
T3: Prompt Engineering for Generative AI by James Phoenix, Mike Taylor, O'Reilly Media, Inc.

Reference Books:
R1: Generative AI with Lang Chain by Ben Auffarth, Packt Publishing
R2: Retrieval Augmented Generation (RAG) AI by Et Tu Code
R3: Natural Language Processing with Transformers, Revised Edition by Lewis Tunstall, Leandro von Werra, Thomas Wolf
R4: The Cambridge Handbook of Responsible Artificial Intelligence

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/Assignment/ Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	3	3	3	2	1	1	2
CO2	3	1	1	1	1	3	1	1	3	1	1	1	1	3	1
CO3	2	3	3	1	2	1	2	2	2	3	3	1	2	1	2
CO4	3	3	3	2	1	1	2	2	3	3	3	2	1	1	2
CO5	3	1	1	1	1	3	1	1	3	1	1	1	1	3	1

Correlation Levels1,2 or 3 as defined below:
1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25307
Course Title	:	Cloud Computing
Pre-requisite(s)	:	Operating System, Computer Networks
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc.(AI& DS / AI&ML / CS)
Semester/Level	:	V/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives: This course enables the students to:

A.	**Understand** the fundamentals of cloud computing, distributed systems, virtualization, and service-oriented models.
B.	**Analyze** different eras of computing and the role of virtualization and cloud reference models in shaping cloud architectures.
C.	**Explore** industry-standard cloud platforms (AWS, Google App Engine, Microsoft Azure) and their core services.
D.	**Evaluate** issues related to energy efficiency, federated clouds, and security challenges in cloud environments.
E.	**Apply** cloud concepts to real-world applications in healthcare, ERP, CRM, mobile computing, and social networking domains.

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

CO1	**Explain** the concepts of cloud computing, distributed systems, virtualization, and service-oriented/utility-oriented computing.
CO2	**Differentiate and compare** cloud reference models, types of clouds, and economic aspects of cloud computing.
CO3	**Demonstrate** the use of AWS, Google App Engine, and Microsoft Azure services for compute, storage, and application deployment.
CO4	**Critically evaluate** energy-efficient architectures, federated clouds, and cloud security defense strategies.
CO5	**Design and propose** cloud-based solutions for applications in healthcare, ERP, CRM, social networking, and mobile cloud computing.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Cloud Computing at a glance, Distributed Systems, Virtualization, Web2.0, Servic computing, Utility-oriented computing, Benefits and Characteristics.	7
Module 2: Eras of Computing, Elements of Distributed Computing, Concepts of Virtualization and its characteristics, Virtualization and cloud computing, cloud reference model, types of clouds, economics of the cloud.	7
Module 3: Cloud Platforms in Industry: Amazon Web Services**:** Compute Services, Storage Services, Communication Services. Google App Engine: Architectural and Core Concepts, Application Life Cycle, Cost Model. Microsoft Azure: Azure Core Concepts, SQL Azure.	7

Module 4: Energy-Efficiency in clouds, Energy-Efficient and Green Cloud Computing Architecture, Market-Oriented Cloud Computing, Federated clouds: characterization and definition, cloud federation stack. Cloud Security and Trust Management: Cloud Security Defense Strategies.	**7**
Module 5: Application of clouds in: Health care, Biology, CRM, ERP, Social Networking, Productivity and Geoscience. Cloudlets for Mobile Cloud Computing.	**7**

Text Books:

1. Buyya Rajkumar, Charles, Vecchiola ChristianamdSelviS. Thamarai "Mastering Cloud Computing", McGraw Hill Education (India) Private Limited.

Reference Books:

1. Hwang Kai, Fox Geoffrey C., Dongarra Jack J., "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/ Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1	2	3	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	2	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	2	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels1, 2 or 3 as defined below:
1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	CourseDeliveryMethods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1,CO2, CO3, CO4	CD1,CD7,CD8
CD2	Tutorials/ Assignments	CO2-CO5	CD1,CD9
CD3	Seminars	CO5	CD1,CD2,CD3
CD4	Mini Projects/Projects	CO5	CD1,CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1,CD2
CD6	Industrial/ Guest Lectures	CO5	
CD7	Industrial Visits/ In-plant Training	CO5	
CD8	Self-learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Simulation	CO5	

COURSE INFORMATION SHEET

Course Code	:	SC25309
Course Title	:	System Programming
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P:0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Describe the utility of different system programs & system tools.
B.	Familiarize with the trade-offs between run-time and compile-time processing (Linking & Loading techniques).
C.	To learn the concepts and techniques behind the designing of various system software.
D.	To organize the functionalities & components of system software & tools into different layers for efficient code generation
E.	Understand the designing of text editors, debuggers etc.

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

CO1	Elaborate the evolution of various system software.
CO2	Define various data structures that helps in the proper functioning of the system programs.
CO3	Analyse basic design of various system software.
CO4	Apply functionalities & components of system software & tools into different layers for efficient code generation.
CO5	Development and designing of text editors, debuggers etc.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Introduction: Evolution of the Components of a Programming System, Assemblers, Loaders, Macros, Compilers, Linkers, Overview of Machine Language.	**7**
Module 2: Instruction Addressing and Execution: Evolution of Operating Systems, Features of an Operating System, The BIOS Boot Process, The System Program Loader, Stack, Instruction Execution and Addressing, Instruction operands, protected Mode.	**7**
Module 3: Assemblers: Overview of Assembly Language, Assembly Language Features, Conventional Segment Directives, Assembly Process, Single Pass Assembler, Design of a 2-Pass assembler for 8088.	**7**
Module 4: Assemblers: Overview of Assembly Language, Assembly Language Features, Conventional Segment Directives, Assembly Process, Single Pass Assembler, Design of a 2-Pass assembler for 8088.	**7**

Module 5: Linkage Editors: Linking and Relocation, Program Relocatability, Linkage Editor and its Application in IBP-PC, Linking for Program Overlays. Software Tools: Spectrum of Software Tools, Text Editors, Interpreter and Program Generators, Debug Monitors, Programming Environments.	**7**

Text Books:

1. Dhamdhere D.M., "System Programming and Operating Systems", 2nd Edition., TMH, New Delhi.

Reference Books:

1. Abel Peter, "IBM PC Assembly Language and Programming", 5th Edition, PHI, New Delhi-2003.
2. Donovan J.J., "System Programming", TMH, New Delhi.

Gaps in the Syllabus (to meet Industry/ Profession requirements) :
1. Application of macros in Language processing system .
2. Application of text editors.

POs met through Gaps in the Syllabus: 3,5
Topics beyond the syllabus/ Advanced topics/ Design:
1. Algorithm for Single Pass Assembler and 2-Pass assembler.
2. Utility of system software for efficient code generation
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/ Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	3	2	2	2	3
CO2	3	1	1	1	1	3	1	1	1	2	1	1	2	1	3
CO3	2	3	3	1	2	1	2	2	2	1	3	1	3	3	2
CO4	1	1	3	3	1	1	1	1	1	1	2	2	3	2	1
CO5	3	3	3	1	2	1	1	2	1	2	1	1	2	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate(Medium) 3: Substantial(High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8and CD9
CD3	Seminars	CO3	CD1, CD2 and CD5
CD4	Mini Projects/Projects	CO4	CD1 CD5, CD8 and CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2 and CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25311
Course Title	:	Exploratory Data Analytics
Pre-requisite(s)	:	
Co-requisite(s)	:	Exploratory Data Analytics Lab
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Outline an overview of exploratory data analysis
B.	Implement data visualization using Matplotlib.
C.	Perform univariate data exploration and analysis.
D.	Apply bivariate data exploration and analysis.
E.	Use Data exploration and visualization techniques for multivariate and time series data. Understand the fundamentals of exploratory data analysis.

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

CO1	Understand the fundamentals of exploratory data analysis.
CO2	Implement data visualization using Matplotlib.
CO3	Perform univariate data exploration and analysis.
CO4	Apply bivariate data exploration and analysis.
CO5	Use Data exploration and visualization techniques for multivariate and time series data.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: EDA fundamentals, understanding data science – Significance of EDA, Making sense of data, Comparing EDA with classical and Bayesian analysis, Software tools for EDA, Visual Aids for EDA, Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.	**7**
Module 2: Data Manipulation using Pandas – Pandas Objects, Data Indexing and Selection, Operating on Data, Handling Missing Data, Hierarchical Indexing, Combining datasets – Concat, Append, Merge and Join, Aggregation and grouping, Pivot Tables – Vectorized String Operations.	**7**
Module 3: UNIVARIATE ANALYSIS: Introduction to Single variable: Distribution Variables, Numerical Summaries of Level and Spread, Scaling and Standardizing – Inequality.	**7**

Module 4: BIVARIATE ANALYSIS: Relationships between Two Variables, Percentage Tables, Analyzing Contingency Tables, Handling Several Batches - Scatterplots and Resistant Lines.	**7**
Module 5: 6 Introducing a Third Variable, Causal Explanations - Three-Variable Contingency Tables and Beyond, Fundamentals of TSA, Characteristics of time series data, Data Cleaning, Time-based indexing, Visualizing, Grouping, Resampling.	**7**

Text Books:

1. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017.
2. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

Reference Books:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/ Seminar Presentation	10
Teacher’s Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	3	3	3	-	-	-	2	2	3	2	3	3	2
CO2	2	2	2	3	3	-	-	-	3	2	2	2	1	2	3
CO3	2	3	2	2	3	-	-	-	2	2	2	1	2	3	1
CO4	2	2	2	2	3	-	-	-	3	2	2	1	2	2	2
CO5	2	2	3	2	1	-	-	-	1	2	2	1	2	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8and CD9
CD3	Seminars	CO3	CD1, CD2 and CD5
CD4	Mini Projects/Projects	CO4	CD1 CD5, CD8 and CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2 and CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25302
Course Title	:	Software Engineering Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Introduce fundamental principles and practices of software engineering and their adaptation for artificial Intelligence and Machine Learning applications.
B.	Develop the ability to elicit, model, and analyze requirements for intelligent software systems with a focus on data-centric and ML-specific needs.
C.	Impart knowledge of modern software design and architectural patterns suitable for scalable AI/ML applications.
D.	Provide hands-on experience in the development, testing, deployment, and automation of AI/ML systems.
E.	Create awareness about software quality assurance, project management, and responsible AI practices ensuring fairness, transparency, ethics, and sustainability in AI/ML software solutions.

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

CO1	Apply software engineering principles to design and implement AI/ML-based applications.
CO2	Identify, elicit, and model user and data requirements for intelligent systems.
CO3	Design scalable architectures and select suitable design patterns for AI/ML pipelines and applications.
CO4	Develop, test, and deploy AI/ML systems using modern tools, frameworks.
CO5	Evaluate AI/ML software for quality, performance, fairness, ethics, and sustainability.

SYLLABUS

List of Programs as an assignment: -

1. Requirement Analysis & SRS Documentation as per IEEE 830 Standard.

Aim: Document functional & non-functional requirements for a system.
Procedure:

a. Identify stakeholders.
b. Collect requirements.
c. Prepare SRS document including functional, non-functional, constraints, assumptions.

2. To model the requirements of a given software project using UML diagrams.
   Tools Required: StarUML / Lucid chart / Draw.io
   Procedure:
   Define system actors and use cases.
   Draw Use Case Diagram.
   Prepare Class Diagram and Sequence Diagram.
   Draw Activity Diagram and State Diagram.
   Validate diagrams with requirements in SRS.

Expected Output:
A set of UML diagrams representing the system's structure and behaviour.

3. To learn how to model a system's high-level data flows by creating a Context-level Data Flow Diagram (DFD) and then decomposing it into a Level-1 DFD that shows major sub-processes, data stores, inputs/outputs, and external entities.
   Tools Required
   a. Drawing tools: Draw.io / Lucidchart / MS Visio / StarUML / pen & paper
   b. Text editor for documentation (MS Word / Google Docs)
   c. Sample system description (case study) — provided by instructor or chosen by the team

4. To estimate the software development effort for a given project using the COCOMO II model.
   Tools Required: COCOMO calculator / Spreadsheet
   Procedure:
   a. Collect project size in terms of KLOC or Function Points.
   b. Select the type of project (organic, semi-detached, embedded).
   c. Apply the COCOMO II formula for effort estimation.
   d. Calculate time, cost, and staffing requirements.
   e. Compare with real project effort data (if available).
   Expected Output:
   Effort estimation report with cost, schedule, and staffing plan.
5. To plan, schedule, and analyze an AI/ML model development project by creating
   1. A Gantt chart that shows task timelines and resource allocation, and
   2. A PERT/CPM network to compute earliest/latest start/finish times, slack, and the critical path.
   Tools Required (choose any)
   a. MS Project, Open Project, Primavera (if available)
   b. MS Excel / Google Sheets (recommended for labs)
   c. Gantt Project (free) / Project Libre
   d. (For PERT/CPM) any spreadsheet + drawing tool (draw.io / Lucidchart).
6. To apply black-box testing techniques—Equivalence Partitioning (EP) and Boundary Value Analysis (BVA)—for identifying optimized test cases that ensure maximum coverage with minimal effort.
   Tools Required
   a. Any programming language (Python/Java/C++) to implement the function under test.
   b. Test frameworks (e.g., JUnit, PyTest, NUnit).
7. To perform white-box testing by applying Basis Path Testing and Cyclomatic Complexity calculation. This includes constructing the Control Flow Graph (CFG) of a program, calculating McCabe's Cyclomatic Complexity, identifying linearly independent paths, and designing corresponding test cases.
8. Build a Classification Model
   Aim: Train and evaluate classification model (Random Forest) on Iris dataset.
   Tools: Python, Scikit-learn
   Procedure: load data → split → train → evaluate.
   Expected Output: Model accuracy.
9. To explore the use of Large Language Models (LLMs) such as ChatGPT and GitHub Copilot for:
   a. Generating functional code solutions.
   b. Automatically creating test cases for code.
   c. Comparing AI-generated code and tests with human-written code for quality and correctness.

10. To practically evaluate fairness, transparency, and sustainability in an ML model using a small dataset, and to take steps to mitigate bias and explain model predictions.

Text Books:

1.Pressman, R. S., & Maxim, B. R. (2020). *Software Engineering: A Practitioner's Approach*, 9thEdition. McGraw-Hill. ISBN: 978-1260548006.
2. Sommerville, I. (2015). *Software Engineering*, 10th Edition. Pearson. ISBN: 978-0133943030.

3. Treveil, M., & Shukla, A. (2023). *MLOps Engineering at Scale*. O'Reilly Media. ISBN: 978-1098106883.

Reference Books:

1. Tim Menzies et al. (2022). *AI for Software Engineering*. Springer. ISBN: 978-3031043024

Gaps in the Syllabus (to meet Industry/ Profession requirements): implementing real world problem.

POs met through Gaps in the Syllabus: PO2, PO5, PO7
Topics beyond the syllabus/ Advanced topics/ Design: Teaching as per the recent trends in industry and research.
POs met through Topics beyond the syllabus/ Advanced topics/ Design: Teaching through research article.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	2	3	2	2	3	2	3	1	3	3	3	2	3
CO2	3	3	2	2	2	1	1	1	2	1	1	2	3	2	3
CO3	2	2	3	3	2	1	1	2	1	1	1	2	2	2	3
CO4	2	2	2	3	3	2	2	2	1	1	2	3	3	3	3
CO5	2	2	2	3	3	2	2	2	2	2	1	3	3	3	3

Correlation Levels1,2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcomes	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors	CO1	CD1, CD2, CD3, CD4
CD2	Assignments	CO2	CD1, CD2, CD3, CD4
CD3	Demonstration / Case studies	CO3	CD1, CD2, CD3, CD5
CD4	Project / Mini-project /Laboratory experiments/Teaching aids	CO4	CD1, CD2, CD3, CD7
CD5	Self- learning such as use of NPTEL materials and internets	CO5	CD1, CD2, CD3, CD5, CD7
CD6	Industrial/guest lectures		
CD7	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25304
Course Title	:	Machine Learning Lab
Pre-requisite(s)	:	Python/R
Co-requisite(s)	:	Basics of Machine Learning
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P:3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	V/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Make use of datasets in implementing the machine learning algorithms.
B.	Understand the basic concepts and techniques of machine learning through programming.
C.	Develop skills of machine learning packages for solving practical problems.
D.	Understand the importance of feature selection and feature transformation.
E.	Implement machine learning concepts and algorithms in any language.

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

CO1	Describe the implementation procedures for machine learning algorithms.
CO2	Understand the features of data to apply real-world problems.
CO3	Apply appropriate datasets to the machine learning algorithms.
CO4	Perform machine learning experiments to solve real-world problems.
CO5	Predict/classify using machine learning algorithms.

SYLLABUS

Module 1: Lab Exercises

1. Write a program to demonstrate matrix operations (addition, multiplication, transpose).
2. Compute eigenvalues and eigenvectors of a given matrix. Interpret them for dimensionality reduction.
3. Represent a dataset as vectors and matrices; perform dot product and check orthogonality of vectors.
4. Implement a simple program to classify whether a given problem is Supervised, Semi-supervised, or Unsupervised.
5. Load a dataset (Iris / Titanic). Perform basic data exploration – display shape, missing values, summary statistics.

Module 2: Lab Exercises

1. Implement Simple Linear Regression on a dataset (e.g., advertising spend vs. sales). Plot regression line with scatter data.
2. Extend to Multiple Linear Regression (e.g., predict house price using features like area, bedrooms, location).
3. Compare Linear vs Logistic Regression using a classification dataset.
4. Implement Logistic Regression on a dataset (e.g., predict if a student passes based on study hours). Show confusion matrix.
5. Compare the accuracy of Logistic Regression with different regularization strengths (L1, L2).

Module 3: Lab Exercises 1. Perform feature selection using correlation analysis (Filter method). 2. Implement a Wrapper method (e.g., recursive feature elimination with sklearn). 3. Apply PCA on Iris dataset and visualize data in 2D space. 4. Implement Naive Bayes Classifier for text classification (spam vs ham emails). 5. Train a Decision Tree & SVM classifier on the same dataset. Compare accuracy and decision boundaries.
Module 4: Lab Exercises 1. Implement K-Means clustering on Iris dataset. Plot clusters. 2. Perform Hierarchical clustering (agglomerative) and plot a dendrogram. 3. Evaluate classification performance with Confusion Matrix, Precision, Recall, and F1-score. 4. Plot an ROC Curve and AUC for a logistic regression classifier. 5. Demonstrate cross-validation and bias-variance tradeoff by training models of different complexities (underfitting vs overfitting).
Module 5: Lab Exercises: 1. Implement a single-layer Perceptron for binary classification (linearly separable data). 2. Implement Forward Propagation in a simple 2-layer neural network. 3. Implement Backpropagation manually for a tiny dataset and show weight updates. 4. Build a simple ANN using Keras/PyTorch for MNIST digit classification. 5. Demonstrate a Recurrent Neural Network (RNN) for sequence data (e.g., text sentiment classification).

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron.
2. C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
VivaVoce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	1	1	1	1	1	1	1	1	1	1	2	3	1	1
CO2	3	2	2	2	1	1	1	1	1	1	1	2	3	1	1
CO3	3	3	3	3	3	3	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	3	2

Correlation Levels 1,2 or 3 as defined below:
1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Mapping between Cos and Course Delivery (CD) methods

CD Code			
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD5, CD8, CD9
CD2	Tutorials/ Assignments	CO2	CD5, CD9
CD3	Seminars	CO3	CD5, CD9
CD4	Mini Projects/ Projects	CO4	CD5, CD6, CD9
CD5	Laboratory Experiments/ Teaching Aids	CO5	CD5, CD6, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25306
Course Title	:	Deep Learning Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	Deep Learning
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI& DS/ AI&ML / CS)
Semester/Level	:	V/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives: This course enables the students to:

A.	Understand the basic component of Machine Learning.
B.	Explore the application areas of Neural Networks.
C.	Understand the idea of Recurrent Neural Networks.
D.	Explore the basic concepts of Feed forward Neural Networks.
E.	Understand the concepts of mathematical modelling.

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

CO1	Develop Neural network models to solve classification problems.
CO2	Design decision trees to solve real world problems.
CO3	Create Bayesian Networks for classification problems
CO4	Design Convolutional & Recurrent Neural Networks to solve problems
CO5	Interpret the training and testing results of deep learning systems.

SYLLABUS

Module 1: Study Bias–Variance: Generate synthetic polynomial data; train models of increasing capacity (linear → 5th degree); plot bias-variance decomposition Build a Naïve Bayes & Bayesian Network Classifier for a small categorical dataset (e.g. spam detection).
Module 2: Develop an MLP (2-layer FFN) Perceptron Learning Algorithm: Implement AND, OR. Record weight updates per epoch. Investigate effect of different hyperparameters – weight initialization, activation function, Learning rates. Develop an MLP (2-layer FFN) Backpropagation Delta Learning Algorithm for binary classification (e.g., Pima Indians Diabetes dataset) using pure NumPy. Use SGD to train, and track loss curves.
Module 3: Develop CNN Comparison: Train a small CNN or MLP on CIFAR-10 (subset) using SGD, Momentum, RMSProp, Adam. Plot training/validation loss curves. Dropout & L2: Train same MLP on Fashion-MNIST with/without dropout and L2; compare generalization and weight norms. Batch Normalization: Integrate Batch Norm into a CNN and observe training speedup and stability. Guided Backprop & Grad-CAM: For images misclassified by your CNN, generate saliency maps and Grad-CAM heatmaps to interpret errors.

Module 4: Sequence Classification with Vanilla: Train an RNN on IMDB sentiment dataset. Compare vanilla RNN vs LSTM/GRU.
Module 5: Attention Mechanism Demo: Implement a simple encoder-decoder with attention on a toy translation task (e.g., digit-to-word). Visualize attention weights.

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, 3rd Edition, 2022.
2. Deep Learning with Python (2nd Edition), François Chollet, Manning Publications, 2021

Reference Books:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, , MIT Press, 2016.
2. Pattern Recognition and Machine Learning, Author: Christopher M. Bishop Publisher: Springer

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
VivaVoce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	3	1	1	1	1	2	1	2	3	3	3
CO2	3	3	3	2	2	1	1	1	1	2	1	2	3	2	3
CO3	3	3	3	2	2	1	1	1	1	2	1	2	3	2	3
CO4	3	3	3	3	3	1	1	1	1	2	1	2	3	3	3
CO5	3	3	3	3	2	1	1	1	1	3	1	3	3	2	3

Correlation Levels 1,2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD1	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD2	Seminars	CO3	CD1,CD2,CD5
CD3	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD4	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD5	Industrial/ Guest Lectures		
CD6	Industrial Visits/ In-plant Training		
CD7	Self-learning such as use of PTEL Materials and Internets		
CD8	Simulation		
CD9	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8

COURSE INFORMATION SHEET

Course Code	:	SC25312
Course Title	:	Exploratory Data Analytics Lab
Pre-requisite(s)	:	Basic R and Python
Co-requisite(s)	:	
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI& DS/ AI&ML / CS)
Semester/Level	:	V/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives: This course enables the students to:

A.	Installing and using data analytics tools
B.	Understand the fundamentals of exploratory data analysis Using Python
C.	Understand the fundamentals of exploratory data analysis Using R
D.	Data visualizations with R ad Python
E.	Exploratory Data Analysis on datasets

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

CO1	Understand the fundamentals of exploratory data analysis Using Python
CO2	Implement the data visualization using Python, use Data exploration and visualization techniques for multivariate and time series data using Python
CO3	Different Data structures in R.
CO4	Implement the data visualization using R, use Data exploration and visualization techniques for multivariate and time series data using R.
CO5	EDA with dataset

SYLLABUS

Module - 1: 1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI. 2. Understanding structured and unstructured data. 3.working with Numpy arrays 4. Pandas data frames, 5.Basic plots using Matplotlib.
Module - 2: 1.Data inspection, cleaning and Validating dataset using Python 2. Explore single feature in dataset using summary statistics and simple data visualization, aggregate functions in pandas, finding association between two variables. 3. Visualizing time series data using PYTHON. 4. Perform exploratory data analysis (EDA) with datasets.
Module - 3: 1.User defined functions in R. 2. Implement different String Manipulation functions in R. 3. Implement different data structures in R : Vectors, Lists, Data Frames and Time Series.

Module - 4: **1. R**eading a csv file and analyze the data by applying statistical operations using R. 2. Create basic exploratory graphs in R. 3. R-programs to explore a new data set and summarize the numerical data and detect anomalies in numerical data.
Module - 5: 1.Explore various variable and row filters in R for cleaning data. 2. Apply various plot features in R on sample data sets and visualize. 3. Perform Time Series Analysis and apply various visualization techniques. 4. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, and user interaction.

Text Books:

1. Norman Matloff, The Art of R Programming, UCDavis2009.
2. Suresh Kumar Mukhiya and Usman Ahmed, Hands-On Exploratory Data Analysis with Python, 2020

Reference Books:

1. Ronald K. Pearson, Explorative Data Analysis using R.
2. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
3. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
VivaVoce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantia l(High)

Mapping between Cos and Course Delivery (CD)methods

CD Code	**Course Delivery Methods**	**Course Outcome**	**Course Delivery Method Used**
CD1	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1, CD9
CD3	Seminars	CO5	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO5	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1, CD2
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self-learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD7, CD8

COURSE INFORMATION SHEET

Course Code	SC25103
Course Title	Generative AI and Applications
Pre-requisite(s)	
Co-requisite(s)	
Credits	: 3
Class schedule/ week	: L: 3 T: 0 P: 0
Class	: B.Sc. (AI & Data Science)
Semester/Level	:VI/1
Branch	: B.Sc.

Course Objectives: This course enables the students to:

A.	Familiarize students with the complexities of generating novel samples using generative models
B.	Understand the fundamental mathematical principles and techniques of generative models.
C.	Enhance the knowledge of neural network and deep learning, programming skills, specifically in the context of generative AI applications.
D.	Understand the flow models and evaluation metrics of generative models.
E.	Apply theoretical knowledge to solve practical problems related to Generative AI.

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

CO1	Understand the fundamentals of Generative AI
CO2	Understand Variational Autoencoders and Generative Adversarial Networks with their applications
CO3	Understand the concepts of Transformers and Large Language Models
CO4	Comprehend Flow Models and their applications
CO5	Understand evaluation techniques for Generative Models

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Overview of generative vs discriminative models, Probability distributions, Bayesian networks, Unsupervised learning, Parametric modelling.	7
Module 2: Basic of autoencoders, Variational Autoencoders (VAEs): theory and architecture, Re-parameterization trick, VAE losses, ELBO, and variational inference	7
Module 3: GAN architecture and training, Various GAN types (DCGAN, WGAN, etc.), GAN evaluation metrics, Likelihood-free learning, JS Divergence	7
Module 4: Transformer architecture, GPT, BERT, Flow model of large language models, Prompt Tuning, Few-shot learning, Fine-tuning, Retrieval Augmented Generation (RAG)	7

Module 5: Flow models, Normalizing flows, Layer normalization, Evaluation metrics for different types of generative models, Density estimation, Importance Sampling for latent variable models, Computational requirements and optimization.	7

Text Book:

1: Generative Deep Learning, 2nd Edition, by David Foster, O'Reilly Media, Inc.
2: Generative AI with LangChain by BenAuffarth, Packt Publishing
3: Prompt Engineering for Generative AI by James Phoenix, Mike Taylor, O'Reilly Media, Inc.

Reference Book:

1: Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville
2: Retrieval Augmented Generation (RAG) AIby Et Tu Code
3: Natural Language Processing with Transformers, Revised Edition by Lewis Tunstall, Leandro von Werra, \ Thomas Wolf
4: The Cambridge Handbook of Responsible Artificial Intelligence

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid-Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (PO)												Program Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	3	3	3	2	1	1	2
CO2	3	1	1	1	1	3	1	1	3	1	1	1	1	3	1
CO3	2	3	3	1	2	1	2	2	2	3	3	1	2	1	2
CO4	1	1	3	3	1	1	1	1	1	1	3	3	1	1	1
CO5	3	3	3	1	2	1	1	2	3	3	3	1	2	1	1

CorrelationLevels1, 2 or 3as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25317
Course Title	:	Soft Computing Techniques
Pre-requisite(s)	:	Basic Mathematics, Programming Fundamentals
Co-requisite(s)	:	None
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand the fundamental concepts of Soft Computing and its necessity.
B.	Learn the theory and applications of Fuzzy Logic, Neural Networks, and Genetic Algorithms.
C.	Apply various Soft Computing techniques to solve real-world problems.
D.	Design and analyze hybrid intelligent systems for optimization and decision-making tasks.
E.	Gain practical exposure to tools and programming for Soft Computing implementations.

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

CO1	Explain the fundamental concepts and components of Soft Computing
CO2	Apply fuzzy logic principles to develop decision-making models.
CO3	Implement Artificial Neural Networks for classification and prediction.
CO4	Utilize Genetic Algorithms and other evolutionary approaches for optimization.
CO5	Design hybrid intelligent systems and apply them to real-world problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Introduction to Soft Computing: Hard vs Soft Computing; Characteristics and Limitations of Soft Computing; Components: Fuzzy Logic, Neural Networks, Genetic Algorithms, Evolutionary Algorithms; Applications of soft computing in various domains.	7
Module 2: Fuzzy Logic: Crisp and Fuzzy Sets; Membership Functions; Fuzzy Set Operations; Fuzzy Number; Fuzzy Relations and Compositions; Fuzzy Inference Systems; Fuzzification and Defuzzification Methods; Fuzzy Controllers and Applications in Engineering. Applications of fuzzy logic in control systems and decision-making	7
Module – 3 : Artificial Neural Networks: Biological vs Artificial Neurons; ANN Architectures (Feed forward, Feedback, Self-Organizing Maps); Perceptron Model and Multilayer Perceptron; Learning Paradigms: Supervised, Unsupervised, Reinforcement; Activation Functions (Sigmoid, Tanh, ReLU, Soft max); Back propagation Algorithm; Convergence Issues; Applications in Pattern Recognition, Speech and Image Processing.	7

Module – 4 : Evolutionary Computing: Introduction to Evolutionary Algorithms; Genetic Algorithm Steps: Encoding, Selection Techniques, Crossover, Mutation; Fitness Functions and Parameter Control; Advanced Genetic Operators; Applications in Optimization, Scheduling, Feature Selection.	7
Module – 5 : Hybrid Systems & Advanced Topics: Need for hybrid systems; Neuro-fuzzy systems: Adaptive Neuro-Fuzzy Inference System (ANFIS); Combining GA with ANN and Fuzzy systems; Particle Swarm Optimization (PSO) – basic concept and working; Ant Colony Optimization (ACO) – overview and applications.	7

Text Books:

1. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley.
2. Jang, Sun & Mizutani, Neuro-Fuzzy and Soft Computing, Pearson.
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.

Reference Books:

1. D. E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson.
2. Simon Haykin, Neural Networks and Learning Machines, Pearson.

Gaps in the Syllabus (to meet Industry/ Profession requirements):

Hands-on implementation of hybrid systems, exposure to advanced AI optimization techniques, real-time case studies in healthcare, IoT and Big Data analytics.

POs met through Gaps in the Syllabus:
PO1, PO2, PO3, PO5

Topics beyond the syllabus/ Advanced topics/ Design:
Deep Learning and Soft Computing, AI applications in robotics, cloud-based optimization systems.

POs met through Topics beyond the syllabus/ Advanced Topics/ Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components		**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment		20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination		20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	2	2	1	1	1	2	2	1	2	2	3	2
CO2	3	3	3	3	3	3	3	1	3	3	1	2	3	3	3
CO3	3	3	3	3	2	2	1	1	2	2	1	2	3	3	2
CO4	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO5	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2,CD6
CD2	Tutorials/Assignments	CO2	CD1,CD4,CD7,CD8
CD3	Seminars	CO3	CD1, CD3,CD4,CD,CD7
CD4	Mini Projects/Projects	CO4	CD1,CD2,CD4,CD5,CD8,CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD3,CD6,CD7,CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25319
Course Title	:	Big Data Analytics
Pre-requisite(s)	:	
Co-requisite(s)	:	Big Data Analytics Lab
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc.(AI& DS / AI&ML / CS)
Semester/Level	:	VI/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives: This course enables the students to:

A.	Introduce the fundamental concepts, evolution, and importance of Big Data in organizations.
B.	Familiarize students with NoSQL databases and their role in handling large-scale data.
C.	Provide knowledge of Hadoop architecture, HDFS, YARN, and its ecosystem for distributed data processing.
D.	Explain the principles and working of MapReduce for large-scale data analysis.
E.	Highlight the roles of professionals in Big Data Analytics and explore its applications across domains.

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

CO1	Describe the characteristics, types, and value of Big Data in business contexts.
CO2	Apply NoSQL database concepts to manage structured, semi-structured, and unstructured data.
CO3	Explain and analyze the working of Hadoop architecture, HDFS, and YARN.
CO4	Implement and evaluate MapReduce programs for distributed data processing.
CO5	Assess the roles of Big Data professionals and apply analytics concepts to real-world domains such as finance, healthcare, and supply chain.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : **Big Data and its Explosion in Organizations:** Data: Definition, Data in digital age, Big Data: Introduction, History of Big Data, Types of Big Data: Structured, Unstructured and Semi-structured Data, Vs of Big Data, Why Big Data Needs Analysis, Creating Values for Businesses using big data, Types of Big Data Analytics, Steps for Big Data Analytics (BDA), Role of Statistics in BDA, Types of Statistical Analysis, Role of Computer Science in BDA.	**7**
Module – 2 : **NoSQL** : Introduction to NoSQL, NoSQL Business Drivers, NoSQL Data Architectural Patterns, Variations of NoSQL Architectural Patterns, Using NoSQL to Manage Big data	**7**
Module – 3 : **Hadoop** : Introduction to Hadoop, RDBMS versus Hadoop, History of Hadoop, Hadoop Overview, Hadoop Distributed File System (HDFS), Hadoop environment, daemons of	

Hadoop, Processing Data with Hadoop, Managing Resources and Applications with Hadoop, YARN Interacting with Hadoop Ecosystem.	**7**
Module – 4 : **Jobs and Tasks**: Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	**7**
Module – 5 : **People Component of BDA:** People as a Prime Component of BDA, Role of a DataAnalyst,BusinessAnalyst,DataEngineer/DataArchitect,BigDataEngineer, DataScientist,DataScientistvsDataManager,MachineLearning(ML)Engineer **Quality Traits:** Personality, Professional Quality Traits **Applications of Big Data Analytics:** Finance Domain, Insurance Sector, HR Domain, Supply Chain Domain, Healthcare Sector, Services Industry.	**7**

Text Books:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

Reference Books:

1. BigData,BigAnalytics:EmergingBusinessIntelligenceandAnalyticTrendsforToday's Businesses by Michele Chambers, AmbigaDhiraj, and Michael Minelli
2. BigData,BlackBook,DreamtechPress

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

AssessmentTool	**%ContributionduringCOAssessment**
ContinuousInternalAssessment	50
SemesterEndExamination	50
ContinuousInternalAssessment	**% Distribution**
FirstQuiz	10
MidSemesterExamination	25
SecondQuiz/Assignment/SeminarPresentation	10
Teacher'sAssessment	5

AssessmentComponents	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
ContinuousInternalAssessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
SemesterEndExamination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	ProgramOutcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1	2	3	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	2	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	2	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2:Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CDCode	CourseDeliveryMethods	CourseOutcome	CourseDeliveryMethodUsed
CD1	Lecture by use of Boards/ LCD Projectors	CO1,CO2, CO3, CO4	CD1,CD7,CD8
CD2	Tutorials/ Assignments	CO2-CO5	CD1,CD9
CD3	Seminars	CO5	CD1,CD2,CD3
CD4	Mini Projects/ Projects	CO5	CD1,CD2
CD5	Laboratory Experiments/ Teaching Aids	CO1-CO4	CD1,CD2
CD6	Industrial/ Guest Lectures	CO5	
CD7	Industrial Visits/ In-plant Training	CO5	
CD8	Self-learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Simulation	CO5	

COURSE INFORMATION SHEET

Course Code	:	SC25321
Course Title	:	Cyber Security
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS)
Semester/Level	:	VI/3
Branch	:	AI & DS

Course Objectives : This course enables the students to:

A.	Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
B.	Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes
C.	Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
D.	E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics.
E.	Provides knowledge about Computer Forensic tools

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

CO1	Understand relevant legislation and codes of ethics.
CO2	Apply Computer forensics and digital detective and various processes, policies and procedures.
CO3	Understand E-discovery, guidelines and standards, E-evidence, tools and environment.
CO4	Learn the techniques of Email and web forensics and network forensics tools.
CO5	Integrate techniques to recover data from computer and hand held devices.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Introduction to Cybercrime, Classifications of Cyber Crimes, Local and Global perspectives on Cybercrime, Cyber offences, Cyberstalking, Cyber crime and cloud computing, cyber crimes through hand held devices.	**6**
Module – 2 : Tools and Methods used in Cybercrime, phishing, steganography, attacks on wireless network. The legal perspectives of Cybercrime and cybersecurity	**6**
Module – 3 : Understanding Digital forensic, Forensics science, computer forensics, and digital forensics. Criminalistics, Analysis of cyber-criminalistics area, Holistic approach to cyber-forensics.	**6**
Module – 4 : Intrusion Detection and Prevention Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems	**7**
Module – 5 : Computer forensic tools, Forensics of Hand held devices, tools for hand held	**5**

device forensics., intellectual property in the cyberspace, The ethical dimension of Cybercrimes	

Text Books:

1. Cyber Security by Nina Godbole, Sunit Belapure Wiley Indian Print 2014

2. John Sammons, The Basics of Digital Forensics, Elsevier

Reference Books:

1. **A Practical Guide to computer forensics Investigations by D.R.Hyaes, Person IT education 2014.**

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8 and CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2 and CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25323
Course Title	:	Computer Organization & Architecture
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P:0
Class	:	B.Sc. (AI& DS/ AI&ML / CS)
Semester/Level	:	VI/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives

This course enables the students to:

A.	To introduce the principles of combinational logic design and enable students to construct and simplify logic circuits using standard digital components.
B.	To develop understanding of sequential logic circuits including flip-flops, counters, and registers, and their role in building memory and timing elements.
C.	To familiarize students with the basics of instruction set architecture, covering instruction formats, addressing modes, and types of instructions used in processors.
D.	To explain the structure and working of input-output systems, focusing on various I/O data transfer techniques such as programmed I/O, interrupts, and DMA.
E.	To provide knowledge of memory organization, including memory hierarchy, types of memory, read/write operations, and how memory interfaces with the CPU.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Design and analyze basic combinational logic circuits using standard digital components
CO2	Design and analyze sequential circuits to perform desired memory and timing functions
CO3	Explain the fundamentals of instruction set architecture, including types of instruction formats, addressing modes, and instruction types.
CO4	Explain the structure and functioning of input-output systems, including data transfer methods like programmed I/O, interrupt-driven I/O, and DMA.
CO5	Explain the organization and operations of memory systems and their interface with the CPU

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : **Digital Computer & Boolean Functions** Introduction to Digital Computers, Boolean Algebra, Theorems & Properties of Boolean Algebra, Boolean Functions, Canonical & Standard Forms, Digital Logic Gates, Gate-Level Minimization, Map Method, Sum-of-Products & Product-of-Sums Simplification.	**7**
Module – 2 : **Combinational Circuits & Sequential Circuits** Analysis & Design Procedure of Combinational Circuits, Adder, Subtractor, Binary Adder-Subtractor, Magnitude Comparator, Decoder, Encoder, Multiplexer. Flip-Flops: SR, JK, D & T, Analysis & Design Procedure of	**7**

Sequential Circuits, Counters & Registers	
Module – 3 : **Central Processing Unit** General Register Organization, Control Word, Microoperations, Stack Organization, Instruction Formats, Addressing Modes, Instruction Set, Timing & Control, Instruction Cycle, Data Transfer & Manipulation, Program Control.	**7**
Module – 4 : **Input-Output Organization** Input-Output Interface, I/O Bus & Interface Modules, I/O Versus Memory Bus, Isolated versus Memory Mapped I/O, Modes of Transfer, Programmed I/O, Interrupt Initiated I/O, Priority Interrupt, Interrupt Cycle, Direct Memory Access (DMA)	**7**
Module – 5 : **Memory Organization** Memory Hierarchy, RAM & ROM chips, Memory Address Map, Memory Connection to CPU, Read & Write Operations**,** Memory Management Hardware.	**7**

Textbooks:

1. M. Morris Mano, "Digital Design", 6th Edition, Pearson Education
2. M. Morris Mano, "Computer System Architecture", Revised 3rdEdition, Pearson Education.

Reference Books:

1. David A. Patterson, "Computer Organization and Design: The Hardware Software / Interface", 5thEdition, 1994.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	**50**
Semester End Examination	**50**
Continuous Internal Assessment	**% Distribution**
First Quiz	**10**
Mid Semester Examination	**25**
Second Quiz/ Assignment/Seminar Presentation	**10**
Teacher's Assessment	**5**

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	**20%[10]**	**20%[10]**	**20%[10]**	**20%[10]**	**20%[10]**
Semester End Examination	**20%[10]**	**20%[10]**	**20%[10]**	**20%[10]**	**20%[10]**

Mapping between Cos and Program Outcomes

Course outcome	ProgramOutcomes (POs)												ProgramSpecific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	3	2	1	1	2	1	2	3	3	2
CO2	3	3	2	3	3	3	2	1	1	1	1	2	3	2	2
CO3	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO4	3	3	3	3	2	2	1	1	1	2	1	2	3	3	3
CO5	3	3	3	3	3	3	3	1	1	2	1	2	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD6
CD2	Tutorials/ Assignments	CO2	CD1,CD2,CD6
CD3	Seminars	CO3	CD1,CD2,CD3,
CD4	Mini Projects/ Projects	CO4	CD1,CD3,
CD5	Laboratory Experiments/ Teaching Aids	CO5	CD1,CD2,CD3, CD4, CD5
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25323
Course Title	:	Computer Organization & Architecture
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L:3 T: 0 P:0
Class	:	B.Sc. (AI& DS/ AI&ML / CS)
Semester/Level	:	VI/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives

This course enables the students to:

A.	To introduce the principles of combinational logic design and enable students to construct and simplify logic circuits using standard digital components.
B.	To develop understanding of sequential logic circuits including flip-flops, counters, and registers, and their role in building memory and timing elements.
C.	To familiarize students with the basics of instruction set architecture, covering instruction formats, addressing modes, and types of instructions used in processors.
D.	To explain the structure and working of input-output systems, focusing on various I/O data transfer techniques such as programmed I/O, interrupts, and DMA.
E.	To provide knowledge of memory organization, including memory hierarchy, types of memory, read/write operations, and how memory interfaces with the CPU.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Design and analyze basic combinational logic circuits using standard digital components
CO2	Design and analyze sequential circuits to perform desired memory and timing functions
CO3	Explain the fundamentals of instruction set architecture, including types of instruction formats, addressing modes, and instruction types.
CO4	Explain the structure and functioning of input-output systems, including data transfer methods like programmed I/O, interrupt-driven I/O, and DMA.
CO5	Explain the organization and operations of memory systems and their interface with the CPU

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : **Digital Computer & Boolean Functions** Introduction to Digital Computers, Boolean Algebra, Theorems & Properties of Boolean Algebra, Boolean Functions, Canonical & Standard Forms, Digital Logic Gates, Gate-Level Minimization, Map Method, Sum-of-Products & Product-of-Sums Simplification.	**7**
Module – 2 : **Combinational Circuits & Sequential Circuits** Analysis & Design Procedure of Combinational Circuits, Adder, Subtractor,	**7**

Binary Adder-Subtractor, Magnitude Comparator, Decoder, Encoder, Multiplexer. Flip-Flops: SR, JK, D & T, Analysis & Design Procedure of Sequential Circuits, Counters & Registers	
Module – 3 : **Central Processing Unit** General Register Organization, Control Word, Microoperations, Stack Organization, Instruction Formats, Addressing Modes, Instruction Set, Timing & Control, Instruction Cycle, Data Transfer & Manipulation, Program Control.	**7**
Module – 4 : **Input-Output Organization** Input-Output Interface, I/O Bus & Interface Modules, I/O Versus Memory Bus, Isolated versus Memory Mapped I/O, Modes of Transfer, Programmed I/O, Interrupt Initiated I/O, Priority Interrupt, Interrupt Cycle, Direct Memory Access (DMA)	**7**
Module – 5 : **Memory Organization** Memory Hierarchy, RAM & ROM chips, Memory Address Map, Memory Connection to CPU, Read & Write Operations**,** Memory Management Hardware.	**7**

Textbooks:

3. M. Morris Mano, "Digital Design", 6th Edition, Pearson Education
4. M. Morris Mano, "Computer System Architecture", Revised 3rdEdition, Pearson Education.

Reference Books:

2. David A. Patterson, "Computer Organization and Design: The Hardware Software / Interface", 5thEdition, 1994.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	**50**
Semester End Examination	**50**
Continuous Internal Assessment	**% Distribution**
First Quiz	**10**
Mid Semester Examination	**25**
Second Quiz/ Assignment/Seminar Presentation	**10**
Teacher's Assessment	**5**

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	3	2	1	1	2	1	2	3	3	2
CO2	3	3	2	3	3	3	2	1	1	1	1	2	3	2	2
CO3	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO4	3	3	3	3	2	2	1	1	1	2	1	2	3	3	3
CO5	3	3	3	3	3	3	3	1	1	2	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1:Slight(Low) 2:Moderate(Medium) 3:Substantial(High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	CourseDelivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD6
CD2	Tutorials/ Assignments	CO2	CD1,CD2,CD6
CD3	Seminars	CO3	CD1,CD2,CD3,
CD4	Mini Projects/ Projects	CO4	CD1,CD3,
CD5	Laboratory Experiments/ Teaching Aids	CO5	CD1,CD2,CD3, CD4, CD5
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25325
Course Title	:	Web Programming
Pre-requisite(s)	:	
Co-requisite(s)	:	Web Programming Lab
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI / 3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Learn about basics of web programming.
B.	Learn HTML, Java Script, XML for scripting.
C.	Learn web-based programming using ASP.NET.
D.	Learn PHP based programming.
E.	Learn Making static and dynamic websites.

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

CO1	Understand the elements of HTML and design static web pages.
CO2	Get familiarized with .net framework.
CO3	Develop interactive web pages using XML.
CO4	Design dynamic website using ASP.net.
CO5	Learn basics of PHP and apply it to develop dynamic websites.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1: Introduction to Internet and HTML: Introduction to Internet, Internet Services, Web Server, Web Client, Domain Registration, Internet Security. HTML Tags, HTML Documents, Header Section, Body Section, Headings, Link Documents using Anchor Tag, Formatting Characters, Font tag, Images and Pictures, Listing, Tables in HTML, HTML iframes, HTML Forms.	**7**
Module – 2: JavaScript: Use of JavaScript in Web Pages, Advantages of JavaScript, Data Types, Variables, Operators and Expressions, Conditional Statements, Array Objects, Date Objects, String Objects, Type Casting, Functions, DOM.	**7**
Module – 3:Understanding XML: Overview of XML, XML Families of Technology, Creating XML Documents, Rules for Well-Formed XML, Discerning Structure, Working with Mixed content, Adding Comments, CDATA Sections, Creating a DTD-The Concept of a Valid XML Document, Creating a DTD for an existing XML File.	**7**

Module – 4:ASP .NET: Building Web Forms Using ASP .NET, Exploring ASP .NET Server Controls, Using ASP.NET Server Controls to Create Web Forms, Understanding the Code behind the Page. Using Validation Controls to Improve Web Forms.	**7**
Module – 5:PHP: Preparing the Use PHP, Exploring PHP for the First Time, Understanding PHP Basics, Displaying PHP Output, Managing PHP Program Flow. Planning a PHP Web Application, Creating and Using a Logon Window.	**7**

Text Books:

1. Xavier C., "Web Technology & Design", New Age International Publishers, New Delhi.
2. BaiXue, Ekedahl Michael, Farrell Joyce, Gosselin Don, Zak Diane, KaparthiShashi, Macintyre Peter, Morrissey Bill, "The Web Warrior Guide to Web Programming", India Edition, Thomson Education.
3. Steven Holzner, —PHP: The Complete Reference, McGraw Hill Education Pvt Ltd.

Reference Books:

1. Dr. Ravinder Singh, Amit Gupta, —Magic with HTML, DHTML and Javascript, Laxmi Publications, First Edition, 2009.
2. Herbert Schildt, —C# 4.0 : The Complete Reference, Tata McGraw Hill.
3. MacDonald, —The Complete Reference ASP.NET, Tata McGraw Hill.
4. Matt Doyle, —Beginning PHP 5.3, Wiley Publishing, 2010

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

AssessmentTool	**%ContributionduringCOAssessment**
ContinuousInternalAssessment	50
SemesterEndExamination	50
ContinuousInternalAssessment	**% Distribution**
FirstQuiz	10
MidSemesterExamination	25
SecondQuiz/Assignment/SeminarPresentation	10
Teacher'sAssessment	5

AssessmentComponents	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
ContinuousInternalAssessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
SemesterEndExamination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	2	2	1	1	2	1	2	2	3	3	3	3
CO2	3	2	2	2	2	1	1	2	2	2	2	3	3	3	3
CO3	3	3	2	2	2	2	1	2	2	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

CorrelationLevels1,2or3asdefined below:
1:Slight(Low)2:Moderate(Medium)3:Substantial(High)

Mapping between Cos and Course Delivery (CD) methods

CDCode	CourseDeliveryMethods	CourseOutcome	CourseDeliveryMethodUsed
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD7
CD3	Seminars	CO3	CD2, CD3, CD6, CD7
CD4	Mini Projects/Projects	CO4	CD3, CD6, CD7
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD3, CD4, CD5, CD6, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25327
Course Title	:	Regression Techniques & Time Series Analysis
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI / 3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	To understand the fundamental concepts of regression analysis and time series data.
B.	To develop skills in building, validating, and interpreting regression and time series models.
C.	To apply forecasting techniques to real-world financial, business, and economic data.
D.	To introduce advanced regression methods and multivariate time series modeling.
E.	To enhance practical skills in using statistical software like Python and R for data analysis

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

CO1	Build and interpret simple and multiple regression models.
CO2	Perform model diagnostics and apply advanced regression techniques (Ridge, Lasso, GLM).
CO3	Analyze time series data and identify its components (trend, seasonality, cyclicity).
CO4	Develop ARIMA, SARIMA, and VAR models for forecasting.
CO5	Apply time series and regression models to real-world business, financial, and economic datasets.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 :Introduction to Regression Analysis Overview of regression analysis and applications, Simple and multiple linear regression, transformations and weighting to correct model inadequacies, diagnostics for leverage and influence.	**8**
Module – 2 : Multiple Regression and Model Adequacy Multiple Linear Regression (MLR) Model, Statistical Inference in MLR, Model Adequacy Checking.	**8**
Module – 3 : : Introduction to Time Series Analysis Introduction to times series data, application of time series from various fields, Components of a time series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves.	**8**

Module – 4 : : Time Series Modeling and Forecasting AR, MA, ARMA models ,ARIMA and SARIMA models ,Forecasting techniques and model selection (AIC, BIC) ,Model diagnostics: residual analysis, Ljung-Box test.	**6**
Module – 5 : Applications and Advanced Topics **Multivariate time series and Vector Auto Regression (VAR), ARCH and GARCH models for volatility** clustering, Applications in stock market, climate data, finance and public health.	**6**

Text Books:

1. Kutner, M.H., Nachtsheim, C., Neter, J., & Li, W. *Applied Linear Statistical Models*. McGraw-Hill.
2. Brockwell, P.J., & Davis, R.A. *Introduction to Time Series and Forecasting*. Springer.
3. Hyndman, R.J., & Athanasopoulos, G. *Forecasting: Principles and Practice*.

Reference Books:

1. Montgomery, D.C., Peck, E.A., & Vining, G.G. *Introduction to Linear Regression Analysis*. Wiley.
2. Chatfield, C. *The Analysis of Time Series: An Introduction*. Chapman & Hall.
3. James, G., Witten, D., Hastie, T., & Tibshirani, R. *An Introduction to Statistical Learning*. Springer.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	1	3	1	2	3	1	1	1	1	2	2	2	2	2	1
CO2	1	2	1	1	1	1	2	1	1	2	2	2	1	2	2
CO3	1	2	1	1	1	1	2	1	2	2	1	2	2	1	1
CO4	1	3	1	2	3	1	1	1	1	2	2	2	2	1	1
CO5	1	3	1	2	1	1	1	1	1	2	2	2	2	2	1

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1 and CD2
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects	CO3	CD1 and CD2
CD5	Laboratory experiments/teaching aids		
CD6	Laboratory experiments/teaching aids		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internet		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25329
Course Title	:	Advanced Applications of ML
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	provide in-depth knowledge of advanced machine learning algorithms and techniques.
B.	develop the ability to analyze and optimize complex, high-dimensional models.
C.	enable students to design and implement scalable machine learning solutions.
D.	cultivate skills for evaluating and improving model performance using advanced metrics.
E.	encourage research-oriented thinking and innovation in machine learning applications.

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

CO1	Formulate and model complex real-world problems using advanced machine learning techniques.
CO2	Analyze and compare the performance of ensemble methods, kernel-based models, and probabilistic approaches.
CO3	Implement scalable machine learning solutions using modern tools and frameworks
CO4	Evaluate models using advanced performance metrics, cross-validation, and hyperparameter tuning.
CO5	Design and present innovative machine learning solutions to open-ended or research-oriented problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Kernel Methods: Review of SVM, Classification and Regression using SVM,Properties of Kernels, Non-Mercer Kernels, Kernel Selection, Multiple KernelLearning	7
Module – 2 : Probabilistic Graphical Models: Bayesian networks, Undirected models, Bayesianlearning, structure learning, Inference on graphical models, exponential families;	7
Module – 3 : Deep Learning: Review of Multi-layer Perceptrons, Backpropagation Algorithms,Stochastic Gradient Descent, Loss and Activation functions, Regularizationstrategies, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN)	7
Module – 4 :Kernel PCA: Long Short-Term Memory Units (LSTM), Auto encoders, Deep-Q Learning; Applications and Case Studies.	7

Module – 5 : Reinforcement Learning: Introduction to Reinforcement Learning, Multi-armedBandit Problem, Finite Markov Decision Processes, Dynamic Programming, EligibilityTraces, Policy Gradient Methods	7

Text Books:

1. J. Shawe-Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis, Cambridge University Press, 2004.

Reference Books:

2. D. Koller and N. Friedman, Probabilistic Graphical Models – Principles and Techniques, MIT Press, 2009.
3. I. Goodfellow, Y. Bengio , A. Courville, Deep Learning, MIT Press, 2017
4. R. Sutton, Reinforcement Learning – An Introduction, MIT Press, 1998

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

AssessmentTool	**%ContributionduringCOAssessment**
ContinuousInternalAssessment	50
SemesterEndExamination	50
ContinuousInternalAssessment	**% Distribution**
FirstQuiz	10
MidSemesterExamination	25
SecondQuiz/Assignment/SeminarPresentation	10
Teacher'sAssessment	5

AssessmentComponents	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
ContinuousInternalAssessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
SemesterEndExamination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	2	3	1	1	1	2	2	2	3	3	3	2
CO2	3	3	2	3	3	1	1	1	2	2	1	3	3	3	2
CO3	3	2	3	2	3	1	1	1	3	2	2	3	3	3	2
CO4	3	3	2	3	3	1	1	1	2	2	1	3	3	3	2
CO5	3	3	3	3	3	1	1	1	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1:Slight(Low) 2:Moderate(Medium) 3:Substantial(High)

Mapping between Cos and Course Delivery(CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and the Internet		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25331
Course Title	:	Evolutionary algorithms
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3
Class schedule/ week	:	L: 3 T: 3 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A	Tostudy about the optimization problem.
B	To study Mult response optimization
C	To explore simulated annealing and Genetic algorithm
D	To study about particle swarm optimization
E	To explore the application of evolutionary algorithm.

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

CO1	Demonstrate principles of optimization process
CO2	Make use of multi response optimization
CO3	Inference to the evolutionary programming
CO4	Evaluate the process parameters for optimization
CO5	Apply optimization techniques in mechanical component design

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : **INTRODUCTION TO OPTIMIZATION** Introduction to optimization – single and multi objective optimization – Evolutionary algorithms – principles of multi objective optimization.	**8**
Module – 2 : **MULTI OBJECTIVE OPTIMIZATION** Convex programming, Karush-Kuhn-Tucker conditions, Direct functional evaluation and derivative based optimization techniques	**8**
Module – 3 : EVOLUTIONARY ALGORITHMS Simulated annealing, Tabu search; NFL theorem; Biological principles of evolution, General scheme of EAs, Representation, Selection schemes, Population evaluation, Variation operators; Constraint handling; Schema theorem; Binary coded genetic algorithm, Real coded genetic algorithm.	**8**

Module – 4 : **EVOLUTIONARY STRATEGIES AND EVOLUTIONARY PROGRAMMING** Evolutionary strategies, Evolutionary programming, genetic programming, Differential evolution, Particle swarm optimization	**8**
Module – 5 : APPLICATIONS OF MULTI-OBJECTIVE EVOLUTIONARY ALGORITHMS Pareto-optimality, Multi-objective evolutionary algorithms; Statistical analysis of EC techniques; Customization in EAs; Applications of multi-objective evolutionary algorithms – Mechanical component design – Truss-structure design – Other applications.	**8**

Text Books:

1.Back, T., Fogal, D. B. and Michalewicz, Z., "Handbook of Evolutionary Computation", Oxford University Press, 1997.
2. Fogel, D. B., "Evolutionary Computation, The Fossil Record", IEEE Press, 2003.

Reference Books:

1.Clerc, M., "Particle Swarm Optimization", ISTE, 2006.
2 Deb, K., "Multi-objective Optimization using Evolutionary Algorithms", Wiley, 2001.
3. Goldberg, D., "Genetic Algorithms in Search, Optimization, and Machine Learning", Addison Wesley, 1989.
4. Price, K. ,Storn, R. M. , and Lampinen, J. A. ,"Differential Evolution: A Practical Approach to Global Optimization", Springer, 2005.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**%Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
MidSemester Examination	25
Second Quiz/Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	3	3	2	2	1	1	2	3	3	2	2	3	3	3
CO2	3	3	3	2	2	1	1	2	3	3	3	2	3	3	3
CO3	3	3	3	3	2	3	1	1	2	2	3	2	3	3	3
CO4	3	3	3	3	2	3	2	1	2	2	3	2	3	3	3
CO5	3	3	3	3	2	2	2	2	2	3	2	2	3	3	2

CorrelationLevels1,2or3asdefined below:
1:Slight(Low)2:Moderate(Medium)3:Substantial(High)

Mapping between Cos and Course Delivery(CD)methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO4	CD1,CD8,CD9
CD3	Seminars	CO5	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO5	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids		CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation	CO1	CD1,CD8

COURSE INFORMATION SHEET

Course Code	:	SC25333
Course Title	:	Quantum Computing and Communication Fundamentals
Pre-requisite(s)	:	Fundamentals of Computing, Computer Architecture, Operating Systems
Co-requisite(s)	:	Computer Algorithms
Credits	:	03
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Introduce the fundamental principles of quantum mechanics as applied to computing and communication.
B.	Develop an understanding of qubits, quantum gates, and circuits for computation.
C.	Explore key quantum algorithms and their applications in solving computationally hard problems.
D.	Familiarize students with quantum error correction, hardware realizations, and complexity theory.
E.	Explain the principles of quantum communication, including QKD, teleportation, and secure protocols. Discuss real-world challenges, ethical issues, and emerging research directions such as quantum internet and post-quantum cryptography.

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

CO1	**Understand** the principles of quantum mechanics relevant to computing and communication, including qubits, superposition, and entanglement.
CO2	**Design and analyze** quantum circuits and implement basic quantum algorithms such as Grover's and Shor's.
CO3	**Apply** quantum error correction methods and evaluate the challenges of real-world quantum hardware.
CO4	**Explain and utilize** quantum communication protocols such as Quantum Key Distribution (QKD) and quantum teleportation for secure communication.
CO5	**Evaluate** the impact of quantum technologies on cryptography, security, and society, while exploring emerging trends like the quantum internet and post-quantum cryptography.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1: Foundations of Quantum Computing Introduction: Classical vs Quantum Computing, motivation, history, Qubits, Quantum States, Superposition, Bloch Sphere representation, Single-qubit gates: Pauli, Hadamard, Phase, etc., Multi-qubit systems, Entanglement, tensor product representation, Measurement in quantum systems: collapse, probabilities Quantum circuits: gate composition and examples, Tutorial/Review: simple quantum circuits & state evolution problems	**07**
Module – 2 : Module 2: Quantum Algorithms & Error Correction Introduction to quantum algorithms and complexity, Grover's Algorithm: principles & implementation, Shor's Algorithm: factoring & cryptographic impact, Other algorithms:	**07**

Deutsch-Jozsa, Simon's Algorithm (overview) Quantum errors: decoherence, noise models, Quantum Error Detection and Correction codes, Fault tolerance and review of algorithmic constraints	
Module – 3 : Module 3: Quantum Hardware & Complexity Theory Physical realizations of qubits: superconducting, trapped ions, photonic systems, Hardware challenges: coherence, scalability, error control, Quantum complexity classes: BQP, QC, comparison with P/NP, Resource estimation: qubits, gate depth, circuit cost, Alternative computation models: measurement-based, adiabatic approaches, Emerging hardware technologies and scalability, Review: resource trade-offs in quantum vs classical systems	**07**
Module – 4 : Quantum Communication Basics of Quantum Communication: channels, transmission, noise, Quantum Key Distribution (QKD): BB84, E91 protocols, Quantum Entanglement and Teleportation, Beyond QKD: authentication, quantum digital signatures, Quantum Channels: noisy vs noiseless, channel capacity, Quantum Repeaters and Satellite-based Quantum Communication, Practical challenges & review of communication protocols	**07**
Module – 5 : Advanced Topics & Future Directions (08 Lectures) Ethical, Legal, and Social Implications of quantum technologies, Quantum Cryptanalysis & Post-Quantum Cryptography, Quantum Channels with realistic noise and error modeling, Scaling quantum networks & integration with classical infrastructure, Emerging research: Quantum Internet, Topological QC, Quantum Cloud Applications: optimization, secure communication, simulation case studies	**07**

Text Books:

Michael A. Nielsen & Isaac L. Chuang. *Quantum Computation and Quantum Information.* 10th Anniversary Edition, Cambridge University Press, 2010.
Eleanor Rieffel & Wolfgang Polak. *Quantum Computing: A Gentle Introduction.* MIT Press, 2011.
Paras Nath Barwal & Kamta Nath Mishra. *Quantum Computing and Communication Fundamentals.* Springer, 2025.

Reference Books:

Peter Wittek. *Quantum Machine Learning: What Quantum Computing Means to Data Mining.* Academic Press, 2014.
Mikio Nakahara & Tetsuo Ohmi. *Quantum Computing: From Linear Algebra to Physical Realizations.* CRC Press, 2008.
Vedran Dunjko & Hans Briegel (Eds.). *Quantum Communication and Information Technologies.* Springer, 2020.
Kamta Nath Mishra, Subhash Chandra Pandey. Cloud-IoT Technologies in Society 5.0, Springer, 2023

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

Mapping Between COs and Course Delivery (CD) methods			
CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, 2, 3, 4	CD1, CD2, CD3, CD8
CD2	Tutorials/Assignments	CO1, 2, 3, 4	CD1, CD2, CD3, CD8
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25316
Course Title	:	AI Applications Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI& DS/ AI&ML / CS)
Semester/Level	:	VI/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives

This course enables the students to:

A.	To develop problem-solving skills using state space search techniques
B.	To understand knowledge representation and reasoning using Prolog programming for AI applications.
C.	To gain practical exposure to supervised learning techniques like Decision Trees, k-NN, Linear & Logistic Regression for classification and regression problems.
D.	To explore unsupervised learning approaches including K-Means, K-Medoids, and EM clustering
E.	To build intelligent applications by integrating AI search, knowledge representation, and machine learning techniques using Python and Prolog

Course Outcomes

After the completion of this course, students will be able to:

CO1	Apply unguided and guided search techniques (BFS, DFS, Best First, A*, MinMax) to solve state space problems.
CO2	Implement knowledge representation and inference mechanisms using Prolog for real-world reasoning tasks.
CO3	Develop supervised ML models such as Decision Trees, k-NN, Linear & Logistic Regression for prediction problems
CO4	Implement unsupervised ML algorithms like K-Means, K-Medoids, and EM for clustering and evaluate performance.
CO5	Integrate AI search, knowledge representation, and machine learning techniques to build AI-based applications.

SYLLABUS

Module - 1: State space Search Techniques

1. Write algorithms and implement them in python for the following unguided search techniques applied to a state space graph. -i) Breadth First Search ii) Depth First Search
2. Write an algorithm for Best First Search –a heuristic-based search and implement it in python.
3. Write a Program to Implement Game problem using Heuristic search, informed search and using MinMax algorithm. Example: i) Tic-Tac-Toe game. ii) 8-Puzzle problem.
4. Write an algorithm for A* Search –a heuristic-based search and implement it in python.

Module - 2: Knowledge representation (Programming in Prolog language)

5. Write a program to implement the following clauses in prolog's syntax to create a knowledge base.

a) The cakes are delicious. b) The pickles are delicious. c) Biryani is delicious. d) The pickles are spicy e) Priya likes coffee f) Priya likes food if it is delicious g) Prakash likes food if it is delicious and spicy.

Perform the following Queries: a) Which food items are delicious? b) Which food itemsdoespriya like? c)

Who relishes coffee and also like pickles? 6. Write a program to implement the following clauses in prolog's syntax to create a knowledge base. a) All fruits are tasty if they are not cooked. b) Apple is a fruit and cooked. c) Mango is a fruit. Perform the following queries: a) Is apple tasty? b) Which fruit is tasty? c) Is banana a fruit? 7. Write a program to implement the following clauses in prolog's syntax to create a knowledge base. a) Hardware is an easy course. b) Books for hardware are available. c) Logic is not an easy course. d) Graphics is an easy course. e) Graphics has eight credits. f) Graphics has a lab component. g) Books for database are available. h) Mary takes compiler. i) X takes Y if Y is an easy course and books for Y are available. j) X takes Y if Y has eight credits and Y has lab component. Perform the following queries: a) Does Mary take graphics course? b) Which course does Mary take? c) Who take graphics course? 8. Write a program in prolog to find the maximum of two numbers.
Module - 3: Supervised learning Machine learning-I 9. Write a program to demonstrate the working of the decision tree based on the following algorithm. a) ID3 algorithm./ C4.5 Algorithm ('entropy') b) CART Algorithm : 'gini' 10. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
Module - 4: Supervised learning Machine learning-II 11. Implement the Linear Regression (Simple and Multiple) by taking the suitable dataset. Draw the fitted line in case of 2D dataset. 12. Implement the Logistic regression algorithm to solve the classification problem for an appropriate dataset. Java/Python ML library classes can be used for this problem.
Module - 5: Unsupervised learning Machine learning 13. Write an algorithm to cluster the data using K means clustering. Implement this K-Means clustering using python language. 14. Write an algorithm to cluster the data using K-Medoids clustering. Implement this K-Medoids clustering using python language. 15. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

Text Books:

Reference Books:

1. Rich E. & Knight K., Artificial Intelligence, 3rd edition, TMH, New Delhi.
2. Mitchell Tom, Machine Learning, Latest Edition, Mc-Graw Hill

Gaps in the Syllabus (to meet Industry/ Profession reuirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
VivaVoce	20

Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	3	2	1	2	1	2	2	3	2	2	3
CO2	2	3	2	2	3	1	1	2	1	3	3	3	2	2	2
CO3	3	3	3	2	3	2	2	2	1	2	2	3	3	2	3
CO4	3	3	3	2	3	1	1	2	1	2	2	3	3	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1:Slight(Low) 2:Moderate(Medium) 3:Substantial(High)

Mapping between Cos and Course Delivery (CD) methods

CD Code			
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25318
Course Title	:	Soft Computing Techniques Lab
Pre-requisite(s)	:	Python
Co-requisite(s)	:	MATAB
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P: 3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VI/3
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand the fundamental concepts of Soft Computing and its necessity.
B.	Learn the theory and applications of Fuzzy Logic, Neural Networks, and Genetic Algorithms.
C.	Apply various Soft Computing techniques to solve real-world problems.
D.	Design and analyze hybrid intelligent systems for optimization and decision-making tasks.
E.	Gain practical exposure to tools and programming for Soft Computing implementations.

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

CO1	Explain the fundamental concepts and components of Soft Computing
CO2	Apply fuzzy logic principles to develop decision-making models.
CO3	Implement Artificial Neural Networks for classification and prediction.
CO4	Utilize Genetic Algorithms and other evolutionary approaches for optimization.
CO5	Design hybrid intelligent systems and apply them to real-world problems.

SYLLABUS

Laboratory Experiments (Practical List):

1. Implementation of basic Fuzzy Set operations (Union, Intersection, Complement) using Python/MATLAB.
2. Design and implementation of Membership Functions (Triangular, Trapezoidal, Gaussian) for fuzzy systems.
3. Development of a Fuzzy Inference System (FIS) using Mamdani approach for temperature control application.
4. Implement a simple Perceptron model for binary classification using Python.
5. Implement a Multi-Layer Perceptron (MLP) using Back propagation for pattern classification.
6. Design and train an Artificial Neural Network for handwritten digit recognition using Python (MNIST dataset).
7. Implement Genetic Algorithm to solve optimization problems (e.g., Travelling Salesman Problem).
8. Implement Genetic Algorithm for feature selection in machine learning datasets.
9. Implement Particle Swarm Optimization (PSO) for function optimization problems.

10. Implement Ant Colony Optimization (ACO) for shortest path problem in a graph.
11. Design and simulate an Adaptive Neuro-Fuzzy Inference System (ANFIS) using MATLAB or Python.
12. Mini Project: Develop a hybrid soft computing solution (combining ANN, Fuzzy Logic, or GA) for a real-world application such as medical diagnosis, stock prediction, or image classification.

Text Books:

1. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley.
2. Jang, Sun & Mizutani, Neuro-Fuzzy and Soft Computing, Pearson.
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.

Reference Books:

1. D. E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson.
2. Simon Haykin, Neural Networks and Learning Machines, Pearson.

Gaps in the Syllabus (to meet Industry/ Profession requirements):

Hands-on implementation of hybrid systems, exposure to advanced AI optimization techniques, real-time case studies in healthcare, IoT and Big Data analytics.

POs met through Gaps in the Syllabus:

PO1, PO2, PO3, PO5

Topics beyond the syllabus/ Advanced topics/ Design:

Deep Learning and Soft Computing, AI applications in robotics, cloud-based optimization systems.

POs met through Topics beyond the syllabus/ Advanced Topics/ Design:

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Students‟ Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

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

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8and CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2 and CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25320
Course Title	:	Big Data Analytics Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	Big Data Analytics
Credits	:	1.5
Class schedule/ week	:	L: 0 T: 0 P:3
Class	:	B.Sc.(AI& DS / AI&ML / CS)
Semester/Level	:	VI/3
Branch	:	AI& DS / AI& ML / CS

Course Objectives

This course enables the students to:

A.	Introduce the fundamental concepts, evolution, and importance of Big Data in organizations.
B.	Familiarize students with NoSQL databases and their role in handling large-scale data.
C.	Provide knowledge of Hadoop architecture, HDFS, YARN, and its ecosystem for distributed data processing.
D.	Explain the principles and working of MapReduce for large-scale data analysis.
E.	Highlight the roles of professionals in Big Data Analytics and explore its applications across domains.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Describe the characteristics, types, and value of Big Data in business contexts.
CO2	Apply NoSQL database concepts to manage structured, semi-structured, and unstructured data.
CO3	Explain and analyze the working of Hadoop architecture, HDFS, and YARN.
CO4	Implement and evaluate MapReduce programs for distributed data processing.
CO5	Assess the roles of Big Data professionals and apply analytics concepts to real-world domains such as finance, healthcare, and supply chain.

SYLLABUS

Module - 1: Big Data Concepts & Analytics Basics
Objective: Understand data types, Big Data characteristics, and basic analytics.
Lab Exercises:

1. **Data Exploration:**
   - Collect a small dataset (CSV/Excel, e.g., student records or sales data).
   - Classify fields into *structured, semi-structured, unstructured*.
   - Identify *Vs of Big Data* present in the dataset.
2. **Statistics Refresher with Python/R:**
   - Write a Python program to compute mean, median, mode, variance, and standard deviation for a dataset.
   - Perform correlation and regression analysis on sample data.
3. **Basic Analytics:**
   - Load a dataset (e.g., COVID cases or stock prices) and generate descriptive statistics and visualizations (histogram, scatterplot).

Module - 2:NoSQL Databases
Objective: Work with NoSQL systems to manage Big Data.

Lab Exercises:

1. **NoSQL Installation:**
   - Install **MongoDB** or **Cassandra**.
   - Verify server startup and basic shell commands.
2. **CRUD Operations in MongoDB:**
   - Create a database `StudentDB`.
   - Insert student documents with fields like *name, course, semester, marks*.
   - Query data: find by condition, projection, sort, update, delete.
3. **NoSQL Data Modeling:**
   - Model a **social media dataset** with collections like `Users`, `Posts`, `Comments`.
   - Perform queries to get all posts by a specific user, top liked posts, etc.

Module - 3:Hadoop Ecosystem

Objective: Set up Hadoop environment and explore HDFS operations.

Lab Exercises:

1. **Hadoop Installation:**
   - Install **Hadoop in pseudo-distributed mode** (local machine or VM).
   - Verify installation using `hadoop version`.
2. **HDFS Basics:**
   - Create directories in HDFS.
   - Upload files into HDFS.
   - Retrieve and delete files.
3. **WordCount Example:**
   - Run the classic `WordCount`MapReduce example on a text file in HDFS.
   - Check outputs and interpret results.
4. **Exploring Hadoop Ecosystem:**
   - Install and run a **Hive** query to create a table and perform basic SQL-like queries.

Module - 4:Map Reduce Programming

Objective: Implement distributed data processing tasks.

Lab Exercises:

1. **Simple MapReduce Program:**
   - Write a Java/Python MapReduce program to count word frequency.
2. **MapReduce with Custom Input/Output Formats:**
   - Process CSV data (e.g., sales dataset).
   - Mapper: extract product and sales.
   - Reducer: calculate total sales per product.
3. **MapReduce Job Scheduling:**
   - Run multiple jobs sequentially and analyze scheduling.
4. **Shuffle & Sort Observation:**
   - Modify WordCount to print intermediate key-value pairs to observe shuffle and sort.

Module - 5:People & Applications in Big Data Analytics

Objective: Apply analytics to real-world domains & understand professional roles.

Lab Exercises:

1. **Role-based Simulation:**
   - Students take roles (Data Analyst, Data Engineer, Business Analyst) and define how they would handle a given dataset (e.g., healthcare patient records).
2. **Domain Applications with Case Study:**
   - Load a **real-world dataset** (Kaggle: Healthcare, Finance, HR, or Supply Chain).
   - Perform descriptive, predictive, or prescriptive analysis using Python libraries (Pandas, Scikit-learn).
3. **Mini Project:**
   - Choose one domain (finance, HR, healthcare, supply chain).
   - Implement a small analytics pipeline:
     - Data collection/cleaning
     - Storage (NoSQL / HDFS)
     - Processing (MapReduce or Spark if available)
     - Visualization of insights

Text Books:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

Reference Books:

1. BigData,BigAnalytics:EmergingBusinessIntelligenceandAnalyticTrendsforToday's Businesses by Michele Chambers, AmbigaDhiraj, and Michael Minelli
2. BigData,BlackBook,DreamtechPress

Gaps in the Syllabus (to meet Industry/ Profession reuirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure
DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
VivaVoce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**ProgramOutcomes (POs)**												**ProgramSpecific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1:Slight(Low) 2:Moderate(Medium) 3:Substantial(High)

MappingbetweenCosandCourseDelivery(CD)methods

CDCode	CourseDeliveryMethods	CourseOutcome	CourseDeliveryMethodUsed
CD1	Lecture by use of Boards/LCD Projectors	CO1,CO2, CO3, CO4	CD1,CD7,CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1,CD9
CD3	Seminars	CO5	CD1,CD2,CD3
CD4	Mini Projects/Projects	CO5	CD1,CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1,CD2
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self-learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Lecture by use of Boards /LCD Projectors	CO1,CO2, CO3, CO4	CD1,CD7,CD8

COURSE INFORMATION SHEET

Course Code	:	SC25326
Course Title	:	Web Programming Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	Web Programming
Credits	:	1.5
Class schedule/ week	:	L: 0 T:0 P: 3
Class	:	B.Sc. (AI& DS/ AI&ML / CS)
Semester/Level	:	VI / 3
Branch	:	AI& DS / AI& ML / CS

Course Objectives

This course enables the students to:

A.	Learn about basics of web programming.
B.	Learn HTML, Java Script, XML for scripting.
C.	Learn web-based programming using ASP.NET.
D.	Learn PHP based programming.
E.	Learn Making static and dynamic websites.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify suitable data structures for given problems.
CO2	Measure time and space complexity of implementations.
CO3	Implement various sorting and searching algorithms.
CO4	Use trees and graphs to solve problems efficiently.
CO5	Justify design decisions for problem-specific data structures

SYLLABUS

Module - 1:

1. Design simple HTML pages to illustrate
   - Ordered, Unordered & Definition Lists
   - Tables
   - Frames
   - Form elements

2. India is a largecountry. Different regions observe variations in climate. The spoken language of one state is quite different from that of another. They wear different types of garments. They celebrate different festivals and perform varied religious rites. People belonging to diverse cultures belong to different religious faiths. In spite of these diversities, Indians feel a sense of unity and oneness among them. Thus, we conclude that India is a land of Unity in Diversity.
   - All the headings should be H2 and green colour.
   - Main heading should be H1 and centre aligned.
   - The background should be yellow colour.
   - There are 10 paragraphs so each of them should be made using P tag.
   - The Introduction and Conclusion paragraphs should have “Times New Roman” font, the size should be 12 and colour should be blue.
   - All the remaining paragraphs text should be pink and magenta coloured in an alternate way.
   - There should be one meaningful picture in the web page with specific dimension.

3. Create a webpage having a list as shown below: • Food. Fruit Apple Mango *Vegetable Potato Tomato Carrot • Dress Ethnic wear Kurta Sherwani Western wear suit jeans • Sports
a. Indoor sports carom table tennis
b. Outdoor sports Cricket Hockey

4. Create a webpage having 10 divisions each having separate background color and text color using tag. At the top right corner there should be an image hyperlink opening in a new webpage. 5. Create a webpage with a form loaded into it and take input of three strings through three textboxes and then concatenate them without using any built-in function.

5. Create a webpage with two tables. First one should have 1 row and 5 columns and the second one with 3 rows and 4 columns. The contents of the first table should be center aligned and contents of the second table should be right aligned. Each column of the first table should have separate colors and each row of the second table should have separate colors.

6. Create a webpage with the following:

- A superscript
- A subscript tag
- Paragraph tag
- Anchor tag
- Image tag
- Definition list tag
- Marquee tag
- Horizontal line tag
- Break tag
- Heading tag

Module - 2:

1) Create a simple webpage that displays a message "Hello, World!" using JavaScript.
2) JavaScript enables dynamic content update without reloading the page. Write a program for updating content on a button click.
3) Write a program to declare variables of different data types and display their values.
4) Write a program tocreate an expression to calculate the sum of two numbers and display it.
5) Write a program to check if a number is positive, negative, or zero.
6) Write a program to create an array of fruits and display each fruit using a loop.
7) Write a program to display the current date and time.
8) Write a program to find the length of a string and convert it to uppercase.
9) Convert a string number to an actual number and add 10.
10) Create a function that takes two numbers and returns their sum.
11) Create a webpage with an input box, a button, and a paragraph. When the button is clicked, display the input value in the paragraph.

Module - 3:

1) Create a simple XML document representing a list of books with title, author, and price.
2) Create an XML document for a student with name, roll number, and subjects enrolled.
3) Identify the error in the following XML and correct it:

```
<employees>
<employee>
<name>Jane</name>
<department>HR</department>
</employee>
<employee>
<name>Mark</name>
<department>Finance</department>
</employees>
```

4) Write an XML element that contains mixed content: text and child elements.
5) Write a program to include JavaScript code inside an XML element using CDATA section.
6) Create a DTD for the 'book' element which contains title, author, and price.

Module - 4:

1) Create a new ASP.NET Web Forms project in Visual Studio.
   - Add a new Web Form named StudentForm.aspx.
   - Add an HTML form with fields for **Name**, **Email**, and **Age** using ASP.NET Server Controls.
   - Set the page's title and master page (if available).

2) Create ValidationDemo.aspx.
   - Add fields: Name, Email, Age, Password, Confirm Password.
   - Add validation controls (Required Field Validator, Range Validator.).
   - For the above program
   - Add a Textbox, Label, and Button to the Web FormSet properties like Text, ID, and CssClass.
   - Add a Dropdown List that displays a list of courses (e.g., "C#", "Java", "Python").
   - Add a CheckBox to allow users to accept terms & conditions. Run the application and observe how server controls are rendered into HTML in the browser.

3) Design a simple **Registration Form** with the following controls:

- TextBox (for username and password)
- RadioButtonList (for gender selection)
- DropDownList (for selecting country)
- Calendar (for date of birth selection)

Add a **Button**labeled "Register". On click, display the entered values in Labels.

Module - 5:

1) Preparing to Use PHP

   - Install **XAMPP**, **WAMP**, or use PHP CLI.
   - Start Apache server.
   - Create a file hello.php inside the htdocs folder (if using XAMPP).
- Open in browser: http://localhost/hello.php.
- Display PHP version using phpversion() function.

2) Exploring PHP for the First Time

- Write and execute a simple PHP script.
- Embed PHP within HTML.

3) Write a program that calculates the area of a rectangle given length and width.
4) Display your favorite quote using both echo and print.
5) Write a PHP script to display the multiplication table of a given number.

Text Books:

1. BaiXue, Ekedahl Michael, Farrell Joyce, Gosselin Don, Zak Diane, KaparthiShashi, MacintyrePeter, Morrissey Bill, "The Web Warrior Guide to Web Programming", India Edition, Thomson Education.
2. Xavier C., "Web Technology & Design", New Age International Publishers, 1st Edn, New Delhi, 2004.

Reference Books:

1. Ross Ivan Bay, "Web Enable Commercial Application Using HTML, DHTML", BPB Publication.

Gaps in the Syllabus (to meet Industry/ Profession reuirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
VivaVoce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**ProgramOutcomes (POs)**												**ProgramSpecific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	**Course Delivery Methods**	**Course Outcome**	**Course Delivery Method Used**
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD7
CD3	Seminars	CO3	CD2, CD3, CD6, CD7
CD4	Mini Projects/Projects	CO4	CD3, CD6, CD7
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD3, CD4, CD5, CD6, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25401
Course Title	:	Blockchain Technology
Pre-requisite(s)	:	Cryptography
Co-requisite(s)	:	
Credits	:	04 L:03 T: 01 P: 00
Class schedule/ week	:	
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VII/-
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	**Introduce the fundamental concepts, structure, and types of blockchain technology, emphasizing its relevance to business and financial systems.**
B.	**Develop an understanding of basic cryptographic principles, blockchain security challenges, and consensus mechanisms without deep technical coding.**
C.	**Explore the role of blockchain in modern financial services, business analytics, supply chain management, and digital assets through real-world case studies.**
D.	**Build analytical skills for assessing blockchain-based solutions, cryptocurrencies, fintech innovations, and related risk management frameworks.**
E.	**Provide hands-on exposure to blockchain applications and tools, enabling students to interpret, visualize, and analyze blockchain-driven business and financial data.**

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

CO1	Explain the fundamental concepts, structure, and working of blockchain technology and distinguish between different types of blockchain networks.
CO2	Apply basic cryptographic principles and understand security mechanisms like hashing, digital signatures, and consensus algorithms used in blockchain systems.
CO3	Analyze the applications of blockchain in finance, business analytics, and financial services, including the role of digital wallets, smart contracts, and tokenization.
CO4	Evaluate the risks, challenges, and regulatory issues associated with blockchain adoption in business and financial ecosystems.
CO5	Demonstrate the ability to interpret blockchain data, perform basic blockchain analytics, and present findings through real-world case studies and hands-on activities.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Basics of Blockchain Technology: Introduction to Distributed Database Systems (DDBMS), Evolution and History of Blockchain, Blockchain Structure: Blocks, Chains, and Transactions, Key Properties of Blockchain (Transparency, Security, Immutability), Types of Blockchains: Public, Private, Consortium, Major Challenges in Blockchain Adoption, Blockchain Networks: Nodes and Architecture	**6**
Module – 2 : Cryptography Concepts for Blockchain: Public Key and Private Key Concepts, Digital Signatures and Authentication, Hashing and its Importance, Merkle Trees, Block Mining, Overview of Consensus Mechanisms: Proof of Work (PoW), Proof of Stake (PoS), Proof of Contribution, Byzantine Fault Tolerance (BFT); Mining Hardware, Common Blockchain Security Issues, Risks and Limitations of Blockchain Technology	**6**

Module – 3 : Blockchain in Finance: Financial Services and Blockchain Integration, Blockchain Applications in Banking, Insurance, and Stock Markets, Understanding Digital Wallets: Hot Wallets vs Cold Wallets, Introduction to Cryptocurrencies: Definition, Features, and Examples, Tokenization of Assets, Risks and Regulatory Challenges in Financial Blockchain Applications	**6**
Module – 4 : Cryptocurrencies and FinTech Innovations: Introduction to the Cryptocurrency Ecosystem, Major Cryptocurrencies: Bitcoin, Ethereum, Blockchain in FinTech: Payment Systems, Smart Contracts, Digital Identity, Cryptocurrency Exchanges: Concept and Types, Legal and Regulatory Perspectives, Future Trends: DeFi (Decentralized Finance), NFTs (Non-Fungible Tokens)	**6**
Module – 5 : Hands On: Smart Contract Platforms: Solidity and Web3 (concepts), Hands-on Activity: Exploring Blockchain Explorer Tools, Group Analytics Project: Analyze a real-world blockchain dataset, Visualization and Presentation of Findings, Case Studies on Blockchain-based Supply Chain Management (SCM) and e-Voting Systems, Hands-on Introduction to Web3.0: Meaning and Importance	**7**

Text Books:

1. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" Daniel Drescher, *Publisher:* Apress
2. "Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World", Don Tapscott and Alex Tapscott,
3. "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications", Imran Bashir, Packt Publishing

Reference Books:

1. "Blockchain for Business: Discover How Blockchain Networks Are Transforming Companies, Driving Growth, and Creating New Business Models", Jai Singh Arun, Jerry Cuomo, Nitin Gaur, *Publisher:* Pearson
2. "The Basics of Bitcoins and Blockchains", Antony Lewis, *Publisher:* Mango
3. "Blockchain Applications in Finance", Umit Hacioglu, *Publisher:* Springer

Gaps in the Syllabus (to meet Industry/ Profession requirements): Nil
POs met through Gaps in the Syllabus: Nil
Topics beyond the syllabus/ Advanced topics/ Design: Nil
POs met through Topics beyond the syllabus/ Advanced Topics/ Design: Nil

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	1	3	2	2	1	3	2	2	3	2	2	1
CO2	3	3	2	2	3	3	2	2	3	3	2	3	3	2	2
CO3	3	2	3	3	3	2	3	3	3	2	3	3	2	3	3
CO4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	3	3	3	2	3	3	3	2	3	3	2	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD8, CD8
CD3	Seminars	CO3	CD1, CD2, CD3, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25403
Course Title	:	Software Project Management and Quality Assurance
Pre-requisite(s)	:	Software Engineering
Co-requisite(s)	:	None
Credits	:	4
Class schedule/ week	:	L: 3 T: 1 P: 0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VII/4
Branch	:	AI & ML

CourseObjectives: Thiscourseenablesthestudents to:

A.	acquire knowledge on software process management
B.	acquire managerial skills for software project development.
C.	understand software economics
D.	understand project organizations and responsibilities
E.	understand software quality and quality management

CourseOutcomes: Afterthecompletionofthiscourse,studentswillbeableto:

CO1	understand software economics, phases in the life cycle of software development, project organization, project control and process instrumentation
CO2	analyse the major and minor milestones, artifacts and metrics from management andtechnical perspective
CO3	design and develop software product using conventional and modern principles of software project management
CO4	Implement a project by managing project schedule, expenses, resources with application of suitable project management tools.
CO5	apply and appreciate quality principles in developing a software product.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1: Conventional Software Management: The waterfall model, conventional software Management performance. **Evolution of Software Economics:** Software Economics, pragmatic software cost estimation. Improving Software Economics- Reducing Software product size, improving software processes, improving team effectiveness, improving automation,	**8**
Module – 2: The old way and the new: The principles of conventional software Engineering, principles of modern software management, Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases. Model based software architectures.	**8**
Module – 3:Work Flows of the process: Software process workflows, Iteration workflows, Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments. Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.	**8**

Module – 4: Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, Process automation Building blocks, Project Control and Process instrumentation: The seven core Metrics, Management indicators, quality indicators, Future Software Project Management.	**8**
Module – 5: Software Quality: Quality Planning, Quality Concepts-Procedural & Quantitative approach to quality management, Software quality models, Processes Related to Software Quality.	**8**

Text Books:

1. Software Project Management. Walker Royce, Pearson Education
2. Software Project Management in practice, Pankaj Jalote, Pearson Education.2016.

Reference Books:

1. Software Project Management, Bob Hughes and Mike Cotterell: Tata McGraw-Hill Edition.
2. Software Project Management, Joel Henry, Pearson Education.

GapsintheSyllabus(tomeetIndustry/Professionrequirements)
POs met through Gaps in the Syllabus:
Topicsbeyondthesyllabus/Advancedtopics/Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

CourseOutcome(CO)AttainmentAssessmentTools&EvaluationProcedure

DIRECT ASSESSMENT

AssessmentTool	**%ContributionduringCOAssessment**
ContinuousInternalAssessment	50
SemesterEndExamination	50
ContinuousInternalAssessment	**% Distribution**
FirstQuiz	10
MidSemesterExamination	25
SecondQuiz/Assignment/SeminarPresentation	10
Teacher'sAssessment	5

AssessmentComponents	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
ContinuousInternalAssessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
SemesterEndExamination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	ProgramOutcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	1	-	2	3	3	3	3	3	2	2	3	3
CO2	3	2	2	-	-	1	2	3	2	2	2	3	2	3	2
CO3	3	3	3	2	3	2	3	3	3	3	3	3	3	3	2
CO4	3	3	3	2	3	2	3	3	3	2	3	2	3	3	2
CO5	2	2	3	2	1	2	2	3	2	3	2	2	2	3	3

CorrelationLevels1,2or3asdefined below:
1:Slight(Low)2:Moderate(Medium)3:Substantial(High)

Mapping between Cos and CourseDelivery(CD) methods

CDCode	CourseDeliveryMethods	CourseOutcome	CourseDeliveryMethodUsed
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD8
CD4	Mini Projects/Projects	CO4	CD1,CD2, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD4
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	**SC25405**
Course Title	:	Research Methodology
Pre-requisite(s)	:	NIL
Co-requisite(s)	:	NIL
Credits	:	03
Class schedule/ week	:	L:3 T:0 P:0
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VII/4
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Get a thorough grounding in introductory research concepts.
B.	Understand the concepts of Research Design in real world studies.
C.	Gain skills in conducting data gathering activities for research studies through various tools
D.	Develop clear concept of sampling methods in tune with the primary data requirements of any given study.
E.	Gain proficiency in writing up research reports for respective purposes as an outcome of a study conducted.

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

CO1	Identify the need and importance of Research in context of different situations and environments.
CO2	Design appropriate Research design according to the research problem and research objectives.
CO3	Prepare questionnaires, interview schedules and implement them for primary data collection in context of any given study.
CO4	Decide and implement the most appropriate probability/non-probability sampling techniques for a given study.
CO5	Communicate research findings clearly and in a user-friendly manner through customized tables and other related tools of data presentation.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : **Research– An Introductory Approach** Meaning, Characteristics and Importance, Types of Research, The Research process (Overview and Steps), The Research problem (Definition, need, importance, steps, and dimensions).	**7**
Module – 2 : **Research Design** Meaning, Characteristics of a Good Research Design, Types of Research Designs, Components of a Research Design.	**7**
Module – 3 : **Sources of Collection of Data**	**7**

Primary Data (Method– questionnaire development, Survey and Observation Methods) Secondary Data (Sources and Precautions in the Use of Secondary Data)	
Module – 4 : **Sampling, Methods of Collecting Data** Meaning, Steps and Types of Probability and Non-probability Sampling	**7**
Module – 5 : **Editing, Tabulation, Report Writing** Meaning and Importance of editing; Meaning, Rules and Types of Tabulation, Parts of a Table, Characteristics, Types, and formats of Report.	**7**

Text Books:

1.Research Methodology- Methods and Techniques, C.R. Kothari, New Age International (P) Limited, Publishers 4835/24, Ansari Road, Daryaganj, New Delhi - 110002

Reference Books:
1. Marketing Research: An Applied Orientation, Naresh K Malhotra and Satyabhusan Dash, Pearson 7/e,2019.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	1	2	2	2	1	2	2	1	1	1	2	1	2	2
CO2	2	2	3	2	2	1	2	2	1	1	1	2	2	2	1
CO3	2	2	3	2	2	1	2	2	1	2	2	2	2	2	2
CO4	3	2	3	3	3	2	2	2	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	3	3	2	3	2	2	2	2	2

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1,CD2,CD4
CD2	Tutorials/Assignments	CO2	CD1,CD2,CD3,CD4
CD3	Seminars	CO3	CD3,CD4
CD4	Mini projects/Projects	CO4	CD1,CD4,CD8
CD5	Laboratory experiments/teaching aids	CO5	CD2,CD4,CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self-learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25407
Course Title	:	Fundamentals of Optimization Techniques
Pre-requisite(s)	:	Matrix Theory
Co-requisite(s)	:	None
Credits	:	3
Class schedule/ week	:	L: 3 T: 0 P: 0
Class	:	B.Sc.(AI & ML)
Semester/Level	:	VII/4
Branch	:	AI & ML

Course Objectives : This course enables the students to:

A.	Understand the fundamental concepts of optimization and its importance.
B.	Learn mathematical formulations of linear and integer programming problems for real world decision making.
C.	Acquire problem-solving skills through systematic techniques such as simplex, dual simplex, sequencing etc.
D.	Develop the ability to handle specialized optimization problems like transportation, assignment and sequencing.
E.	Gain exposure to applications of optimization techniques in resource allocation.

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

CO1	Formulate and solving Linear Programming Problems using graphical and analytic methods.
CO2	Solve transportation and assignment problems using efficient methods and apply them in real-world optimization contexts.
CO3	Apply sequencing models for job scheduling and workflow optimization
CO4	Formulate and solve integer programming problems.
CO5	Fundamentals of Network Analysis using CPM and PERT.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Linear Programming Problem (LPP) Introduction, Formulation of Linear Programming Problems, Solution of LPP using Graphical method, Simplex Method, Big-M Method & Two-Phase Method. Duality in Linear Programming, Dual Simplex Method.	**9**
Module – 2 : Transportation & Assignment Problems Transportation Problem: Formulation, balanced & unbalanced problems, Initial feasible solutions: NWCM, Least Cost, Vogel's Approximation, Optimality tests: MODI method, Degeneracy in transportation problem **Assignment Problem:** Formulation, Hungarian Method, Balanced & unbalanced problems. Variants in Assignment problem: maximization, restrictions, multiple assignments.	**7**
Module – 3 : Sequencing Problem Concept of Sequencing in optimization, Sequencing 'n' jobs on 2 machines (Johnson's procedure), Sequencing 'n' jobs on 3 machines, processing 2	**5**

jobs through 'm' machines, Applications.	
Module – 4 : Integer Programming Introduction to Integer Programming. Gomory's Cutting Plane Method for pure and mixed integer, Branch and Bound Method, Applications.	**7**
Module – 5 : Network Analysis (CPM and PERT): Network and basic components, Determination of critical path: Critical Path Method (CPM), Project Evaluation and Review Techniques(PERT).Time-cost optimization Algorithm.	**7**

Text Books:

1. Hiller, S. & Lieberman,G.J.,"Operations Research", 9/e , TMH, New Delhi–2012.
2. Taha,H.A.,"Operations Research", 9/e , Pearson Education , New Delhi-2013.

Reference Books:

1. Swarup, Kanti; Gupta, P. K.; Mohan, M., "Operations Research" Sultan Chand & Sons.
2. Pai,P.P.,"Operations Research", 1/e, Oxford University Press 2012.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	3	2	0	0	1	2	2	2	3	3	2
CO2	3	3	3	3	3	2	0	0	1	2	2	2	3	3	2
CO3	3	3	3	3	3	2	0	0	1	2	2	2	3	3	3
CO4	3	3	3	3	3	2	0	0	1	2	2	2	2	3	2
CO5	3	3	3	3	3	2	0	0	1	2	2	2	2	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors	CO1	CD1, CD2, CD3
CD2	Tutorials/Assignments	CO2	CD3, CD5
CD3	Seminars/ Quiz (s)	CO3	CD3, CD5, CD7
CD4	Mini projects/Projects	CO4	CD2, CD3, CD4, CD6, CD7
CD5	Teaching aids, Self-Learning	CO5	CD1, CD3, CD5, CD7
CD6	Industrial/guest lectures		
CD7	Group Study, Coding Contest		
CD8			
CD9			

COURSE INFORMATION SHEET

Course Code	:	SC25409
Course Title	:	Natural Language Processing
Pre-requisite(s)	:	
Co-requisite(s)	:	NLP Lab
Credits	:	L: 3 T: 0 P: 0
Class schedule/ week	:	
Class	:	B.Sc. (AI & DS)
Semester/Level	:	VII/ 4
Branch	:	AI & DS

Course Objectives: This course enables the students to:

A.	To Identify the basic components of Natural Language Processing (NLP) and analyze its application areas.
B.	To interpret the fundamental ideas and concepts of Language Modelling.
C.	To understand and Apply compare different modelling techniques for Parts-of-Speech (POS) Tagging.
D.	To Examine and design parsing techniques used in NLP.
E.	To Construct Vector Semantics to measure similarity and analyze Latent Semantic Analysis (LSA).

Course Outcomes: After completion of this course, students will be able to:

CO1	Identify and explain the basic components of Natural Language Processing (NLP) and analyze its application areas.
CO2	Describe and interpret the fundamental concepts of Language Modelling and evaluate their relevance in NLP systems.
CO3	Apply and compare different modelling techniques for Parts-of-Speech (POS) Tagging.
CO4	Examine, design, and evaluate parsing techniques used in NLP.
CO5	Construct Vector Semantics to measure similarity and analyze Latent Semantic Analysis (LSA) for semantic representation.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module-1: **Introduction to NLP:** introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model.	7
Module-2: **Language Modelling:** N-gram and Neural Language Models Language Modelling with N-gram, Simple N-gram models, smoothing (basic techniques), Evaluating language models; Neural Network Basics, Training; Neural Language Model, Case study: application of neural language model in NLP system development.	7
Module-3:	7

Parts-of-speech Tagging**:** basic concepts; Tag set; Early approaches: Rule based and TBL; POS tagging using HMM, Viterbi Model for optimization of HMM.	
Module-4: **Parsing Basic concepts**: top down and bottom-up parsing, Treebank; Syntactic parsing: CKY parsing; Statistical parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs.	**7**
Module-5: **Semantics**: Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; Embeddings from prediction, Introduction to WorldNet.	**7**

Textbooks:

1. Jurafsky Dan and Martin James H., Speech and Language Processing **(3rd ed.)**

Reference Books:

1. Jurafsky D. and Martin J. H., Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008. (R1)
2. Goldberg Yoav, A Primer on Neural Network Models for Natural Language Processing. (R2)

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	2	1	1	1	2	1	3	1	1	3	2	2
CO2	3	3	3	1	3	1	1	1	3	1	2	2	3	2	2
CO3	3	3	3	3	3	1	2	2	2	1	1	2	3	3	2
CO4	3	3	3	1	3	2	1	1	2	1	1	2	3	3	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25410
Course Title	:	NLP Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	Natural Language Processing
Credits	:	L: 0 T: 0 P: 3
Class schedule/ week	:	
Class	:	B.Sc. (AI & DS)
Semester/Level	:	VII/ 4
Branch	:	AI & DS

Course Objectives

This course enables the students to:

A.	Develop a strong foundation in linguistic concepts, text processing, and the theoretical principles underlying Natural Language Processing
B.	Gain hands-on experience in tokenization, stemming, lemmatization, part-of-speech tagging, syntactic parsing, and named entity recognition using modern NLP libraries.
C.	Learn to represent text using statistical and vector-based models (TF-IDF, Word2Vec, BERT) and evaluate their performance in various NLP tasks.
D.	Build end-to-end solutions for text classification, sentiment analysis, information retrieval, machine translation, and dialogue systems.
E.	Examine deep learning approaches for NLP, such as RNNs, LSTMs, and transformers, and understand current research challenges and ethical considerations in language technology.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Able to perform tokenization, stop-word removal, stemming, and lemmatization on raw text data using NLP libraries.
CO2	May construct n-gram language models, apply smoothing techniques, and evaluate them using perplexity and accuracy measures.
CO3	Able to design and implement basic applications such as sentiment analysis, text classification, and named entity recognition using machine learning techniques.
CO4	May utilize Word2Vec, GloVe, and transformer-based embeddings (e.g., BERT) to solve real-world NLP tasks.
CO5	Can interpret model performance, fine-tune hyperparameters, and document results for reproducibility and improvement.

SYLLABUS

Module - 1:
Introduction & Text Preprocessing: Familiarize students with basic NLP tasks and text handling.
Experiments:
1. Install and configure NLP libraries (NLTK, spaCy, HuggingFace, scikit-learn).
2. Implement tokenization, stop-word removal, stemming, and lemmatization.
3. Perform Part-of-Speech (POS) tagging and Named Entity Recognition (NER) using spaCy or NLTK.
4. Explore text normalization techniques: lowercasing, removing punctuation, handling special characters.

Module - 2:
Language Modelling & Feature Representation: Learn statistical approaches for text representation and language modelling.
Experiments:
1. Implement unigram, bigram, and trigram language models.

2. Apply smoothing techniques (Laplace, Add-k, Good-Turing). 3. Represent text using Bag-of-Words and TF-IDF and compare their effectiveness. 4. Train a simple Naïve Bayes text classifier (e.g., spam detection).
Module - 3: **Word Embeddings & Semantic Analysis:** Understand distributed representations and semantic similarity. **Experiments:** 1. Implement Word2Vec (CBOW and Skip-gram) using Gensim. 2. Use pre-trained embeddings (Word2Vec, GloVe, FastText) for similarity analysis.
Module - 4: Deep Learning for NLP: Explore neural network-based NLP models. Experiments: 1. Implement a simple Feedforward Neural Network for text classification. 2. Build an RNN/LSTM for next-word prediction or sentiment analysis. 3. Evaluate models using accuracy, F1-score, and confusion matrix.
Module - 5: NLP Applications & Mini-Project: Apply end-to-end NLP concepts to real-world problems. Experiments/Projects: 1. Sentiment analysis of product/movie reviews. 2. Chatbot implementation using a rule-based or retrieval-based approach.

Textbooks:

2. Jurafsky Dan and Martin James H., Speech and Language Processing **(3rd ed.)**

Reference Books:

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems", O'Reilly Media, 2020.
2. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.
3. Jalaj Thanaki, "Python Natural Language Processing", Packt Publishing, 2017

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day-to-day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	1	1	1	1	1	1	1	1	2	1	1	1
CO2	3	3	2	2	2	1	1	1	1	1	1	2	1	1	1
CO3	3	3	3	2	3	2	1	1	2	2	2	2	1	1	1
CO4	3	3	3	3	3	2	1	1	2	2	2	2	1	1	1
CO5	3	3	3	3	3	3	1	1	2	3	2	3	2	2	2

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code : SC25415
Course Title : Full Stack Application Development
Pre-requisite(s) : SC25325 Web Programming
Co-requisite(s) : SC25416 Full Stack Application Development Lab
Credits : 3 L: 3 T: 0 P:0
Class schedule/ week : 3
Class : B.Sc. (AI & DS)
Semester/Level : VII /4
Branch : AI & DS

Course Objectives : This course enables the students to:

A.	To implement static, dynamic webpages using HTML5, CSS3, Bootstrap.
B.	To introduce Node.js, Express.js implementation for server-side programming
C.	Demonstrate database management with Mongo DB.
D.	To experiment with single page application development using Angular and to use git version control system.
E.	To apply concepts through industry-style mini projects and a capstone project.

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

CO1	Build a custom website with HTML, CSS, and Bootstrap.
CO2	Develop the server – side implementation using Node.js, Express.js
CO3	To make use of database management with Mongo DB drivers for web development.
CO4	Design a Single Page Application using Angular and establish version control in GitHub.
CO5	Demonstrate teamwork and agile practices through project work.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Introduction to Full Stack Development; Web Architectures (Monolithic, Client-Server, Microservices); MVC & SPA. HTML5 structure, semantic tags, forms; CSS3 basics (selectors, box model, Flexbox, Grid, responsive design). Introducing to React, JavaScript for React: Declaring Variables, Creating Functions, Compiling JavaScript, Objects and Arrays, Asynchronous JavaScript, Classes, Functional Programming with JavaScript: Functional Concepts - Immutability, Pure Functions, Data Transformations, Higher-Order Functions, Recursion, Composition, Putting It All Together.	7
Module – 2 : Node.js: Getting started with Node, Environment setup, simple server, Modules, Node.js file system module, NPM, Events, Upload the file, Send an Email. Express.js: Introduction, Setup environment, Basic Routing, Middleware, Templating, RESTful API design.	7
Module – 3 : Mongo DB Drivers: Introduction, create database, insert, create collection, find, update, drop, CURD Operations, Creating UI, Form validation and user register, Password	7

Encryption, login functionality. MERN Stack Integration: Connecting React frontend with Node.js backend; Fetching APIs in React.	
Module – 4 : App development using Angular & AngularJS: Getting Started with Angular, Differences b/w Angular & AngularJS, Components, Properties, Events, Data Binding, AngularJS MVC architecture AngularJS modules, AngularJS Directives, DOM.	7
Module – 5 : Git & Version control: Getting Started with git, working with a Local Repository, Working with Remote Repository. Agile & Scrum; Case studies of real-world full stack apps, Capstone Project examples.	7

Text Books:

1. Northwood, Chris. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer. Apress, 2018.
2. Node.js, MongoDB, and AngularJS Web Development by Brad Dayley Released June 2014 Publisher(s): Addison-Wesley Professional.

Reference Books:

1. Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App Kindle Edition by Greg Lim (Author).
2. Ihrig CJ, Bretz A. Full stack JavaScript development with MEAN. Site Point; 2014 Dec 24.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	3	1	2	1	1	1	2	2	3	1	3	3	2
CO2	2	3	3	3	2	1	1	2	2	2	3	1	3	2	2
CO3	2	2	2	1	3	2	1	1	2	2	3	2	2	2	2
CO4	2	3	2	3	3	2	2	1	2	2	2	2	1	2	3
CO5	1	1	2	2	3	2	1	1	3	3	3	1	2	3	2

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25416
Course Title	:	Full Stack Application Development Lab
Pre-requisite(s)	:	SC25326 Web Programming Lab
Co-requisite(s)	:	SC25415 Full Stack Application Development
Credits	:	1.5 L: 0 T: 0 P:3
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS)
Semester/Level	:	VII / 4
Branch	:	AI & DS

Course Objectives

This course enables the students to:

A.	To develop proficiency in designing and implementing dynamic, data-driven web applications using both front-end and back-end technologies.
B.	To provide hands-on experience with modern full stack frameworks and tools, enabling students to build responsive and interactive user interfaces.
C.	To impart practical knowledge of server-side programming, database connectivity, and API integration for seamless client–server communication.
D.	To cultivate skills in deployment, testing, and version control, ensuring students can manage and maintain full stack applications effectively.
E.	To promote problem-solving, teamwork, and project-based learning, encouraging students to develop scalable and real-world web solutions.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify suitable data structures for given problems.
CO2	Measure time and space complexity of implementations.
CO3	Implement various sorting and searching algorithms.
CO4	Use trees and graphs to solve problems efficiently.
CO5	Justify design decisions for problem-specific data structures

SYLLABUS

Module - 1:

1. Write a script that Logs "Hello, World!" to the console. Create a script that calculates the sum of two numbers and displays the result in an alert box.
2. Create an array of 5 cities and perform the following operations: Log the total number of cities. Add a new city at the end. Remove the first city. Find and log the index of a specific city.
3. Read a string from the user, Find its length. Extract the word "JavaScript" using substring() or slice(). Replace one word with another word and log the new string.
4. Write a function isPalindrome(str) that checks if a given string is a palindrome (reads the same backward).
5. Create an object student with properties: name (string), grade (number), subjects (array), displayInfo() (method to log the student's details)
6. Write a script to dynamically add a passed property to the student object, with a value of true or false based on their grade. Create a loop to log all keys and values of the student object.
7. Create a button in your HTML with the text "Click Me". Add an event listener to log "Button

clicked!" to the console when the button is clicked. Select an image and add a mouseover event listener to change its border color. Add an event listener to the document that logs the key pressed by the user.

8. Static Website Design – Create a multi-page personal portfolio using HTML5 (semantic tags) and CSS3 (flexbox/grid).
9. Responsive Layout – Build a product landing page that adapts to desktop, tablet, and mobile using Bootstrap.
10. Form Handling & Validation – Design a registration form with HTML5 input types and JavaScript-based validation.
11. JavaScript Functional Concepts – Write programs demonstrating higher-order functions, recursion, and immutability.
12. React Basics – Build a simple React app with multiple components (header, footer, and list rendering).

Module - 2:

1. Build a React application to track issues. Display a list of issues (use static data). Each issue should have a title, description, and status (e.g., Open/Closed). Render the list using a functional component.
2. Create a component Counter with A state variable count initialized to 0. Create Buttons to increment and decrement the count. Simulate fetching initial data for the Counter component using useEffect (functional component) or componentDidMount (class component). Extend the Counter component to Double the count value when a button is clicked. Reset the count to 0 using another button.
3. Simple Node.js Server – Write a Node.js script to create a server that serves static HTML content.
4. File System Operations – Create a Node.js app to read, write, and update files.
5. Express.js Routing – Build a REST API with endpoints for CRUD operations on an in-memory dataset (e.g., students).
6. Middleware Implementation – Implement logging and authentication middleware in Express.
7. Email & File Upload – Build a file upload feature and an email sender using Nodemailer.

Module - 3:

1. Install the MongoDB driver for Node.js. Create a Node.js script to connect to the shop database. Implement insert, find, update, and delete operations using the Node.js MongoDB driver. Define a product schema using Mongoose. Insert data into the products collection using Mongoose. Create an Express API with a /products endpoint to fetch all products. Use fetch in React to call the /products endpoint and display the list of products. Add a POST /products endpoint in Express to insert a new product. Update the Product List, After adding a product, update the list of products displayed in React.
2. MongoDB CRUD Operations – Write scripts to create database, collections, and perform insert, update, delete, and find.
3. User Registration System – Create a registration form with data stored in MongoDB.
4. Password Encryption – Implement bcrypt-based password hashing for user authentication.
5. Login Functionality – Build login/logout features with session or JWT authentication.
6. MERN Integration – Connect a React frontend with a Node.js backend to fetch and display MongoDB data.

Module - 4:

1. Angular Components – Build a small Angular app with multiple components (navigation, content, footer).

2. Data Binding – Demonstrate one-way and two-way data binding in Angular.
3. AngularJS MVC – Build a to-do list using AngularJS demonstrating controllers and directives.
4. Events & Properties – Create an Angular app that handles form input and button click events.
5. DOM Manipulation with Directives – Use AngularJS directives to dynamically display and hide elements.

Module - 5:

1. Git Basics – Initialize a repository, create commits, and manage branches locally.
2. Remote Repository – Push and pull code from GitHub, resolve conflicts.
3. Collaboration Project – Work in teams, simulate pull requests and code reviews.
4. Agile Simulation – Create a small project backlog, assign tasks, and run a mock sprint.
5. Capstone Mini Project (Integrated) – Develop a mini full stack app (e.g., Blog System or Task Manager) using MERN/MEAN, deploy to GitHub, and maintain version control.

Text Books:

3. Northwood, Chris. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer. Apress, 2018.
4. Node.js, MongoDB, and AngularJS Web Development by Brad Dayley Released June 2014 Publisher(s): Addison-Wesley Professional.

Reference Books:

3. Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App Kindle Edition by Greg Lim (Author).
4. Ihrig CJ, Bretz A. Full stack JavaScript development with MEAN. Site Point; 2014 Dec 24.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	3	1	2	1	1	1	2	2	3	1	3	3	2
CO2	2	3	3	3	2	1	1	2	2	2	3	1	3	2	2
CO3	2	2	2	1	3	2	1	1	2	2	3	2	2	2	2
CO4	2	3	2	3	3	2	2	1	2	2	2	2	1	2	3
CO5	1	1	2	2	3	2	1	1	3	3	3	1	2	3	2

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25421
Course Title	:	Computer Vision
Pre-requisite(s)	:	
Co-requisite(s)	:	SC25422 Computer Vision Lab
Credits (3)	:	L: 3 T: 0 P:0
Class schedule/ week	:	
Class	:	B.Sc. (AI & DS)
Semester/Level	:	VII/4
Branch	:	B.Sc. (AI & DS)

Course Objectives : This course enables the students to:

A.	Understand the field of Computer vision, Radiometry, photometry. Introduction and Analysis of Physics of color.
B.	Apply fundamental of image processing for Image enhancement and filtering
C.	Implementation of feature detection and matching using feature matching tehniques
D.	Analyze of Image segmentation, clustering and texture classification.
E.	Understand the Epipolar geometry, Camera calibration, pose estimation, and Multi-view geometry and triangulation and application of deep learning in CV.

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

CO1	Describe the Computer vision, Radiometry, photometry. Introduction and Analysis of Physics of color.
CO2	Understand to implement image processing fundamentals : Spatial domain and Frequency domain
CO3	Implementation of feature detection and matching using feature matching technique.
CO4	Analysis of Image segmentation, clustering and texture classification
CO5	Understand of Epipolar geometry, and Multi-view geometry and triangulation..

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Introduction to Computer Vision, Image formation and camera models, Radiometry, photometry, and imaging geometry, Human visual perception basics, Color: The Physics of color, Human Color Perception, Representing Color. Sampling, quantization, and image Resolution.	**7**
Module – 2 : Image processing fundamentals: **Spatial domain methods:** contrast stretching, histogram equalization, image negation, thresholding, Smoothing (mean, Gaussian) and sharpening (Laplacian, high-boost) filters. Geometric transformations. **Frequency domain methods:** Fourier transform basics, low-pass and high-pass filtering	**7**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. K.N. Mishra | Dr. Sounak Paul | Dr. Soumya Ray

Module – 3 : Feature Detection and Matching: Interest point detectors, Corner, edge, and blob detection, Scale-space and multi-scale feature extraction (SIFT, SURF) Feature descriptors and invariance (rotation, scale, illumination), Feature matching techniques RANSAC for robust estimation.	**7**
Module – 4 : Image segmentation (thresholding, region growing, graph cuts), Clustering in vision (k-means, mean-shift, spectral clustering), Object detection frameworks (HOG, DPM, Viola–Jones), Object recognition pipelines, Texture analysis and classification Scene categorization and semantic segmentation	**7**
Module – 5 : Epipolar geometry and the fundamental matrix, Camera calibration and pose estimation, Stereo vision and depth estimation, Structure from motion (SfM), Optical flow estimation (Lucas–Kanade, Horn–Schunck), Multi-view geometry and triangulation. Application of deep leanring in Computer Vision.	**7**

Text books:

1. Szeliski, Richard., Computer Vision: Algorithms and Applications., Springer, 2021. 2nd Ed.
2. Forsyth, D. A., and Jean Ponce. Computer Vision: A Modern Approach., Second Edition, Pearson Education, 2015.

Reference Books:

3. Simon J.D. Prince, Computer vision: models, learning and inference, Cambridge University Press.
4. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning., First Edition, MIT Press, 2016.
5. Gonzalez, Rafael C., Woods, Richard E. – Digital Image Processing, 4th ed., Pearson, 2018.
6. Sonka, Milan, Hlavac, Vaclav, Boyle, Roger – Image Processing, Analysis, and Machine Vision, Cengage,

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	2	2	2	1	1	1	1	2	2	3	2	1	2	2
CO2	2	3	3	2	1	1	1	1	3	2	2	2	2	3	2
CO3	2	2	3	1	1	1	1	1	3	1	2	1	2	2	1
CO4	2	3	3	1	2	3	2	2	3	1	1	1	3	3	2
CO5	2	3	3	3	2	1	1	1	3	1	2	3	2	2	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25422
Course Title	:	Computer Vision Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	SC25421 Computer Vision
Credits (1.5)	:	L: 0 T: 0 P:3
Class schedule/ week	:	
Class	:	B.Sc. (AI & DS)
Semester/Level	:	VII/4
Branch	:	B.Sc. (AI & DS)

Course Objectives

This course enables the students to:

A.	Implement the program to perform the input/output operation for images data.
B.	Implementation of the program to perform the fundamental operations of image processing
C.	Implementation of feature detection and matching using feature matching techniques.
D.	Implementation of image segmentation, clustering and texture classification.
E.	Design and implementation of camera calibration algorithm and deep leaning models

Course Outcomes

After the completion of this course, students will be able to:

CO1	Implementation of program to handling the images data for I/O operations and other operations
CO2	Implementation of various operations on image using spatial domain and frequency domain image processing.
CO3	Implementation various feature detection and matching algorithm.
CO4	Implementation of image segmentation techniques and object detection texture analysis.
CO5	Design and implementation of camera calibration algorithm and deep leaning models.

SYLLABUS

Module - 1: Program for reading, display and writing the images. Program to find information about an image e.g. size, type of images, format of the image and resolution of the images etc. Program to work with color images e.g. separation of color channels, Manipulation in channels etc.
Module - 2: Program to implement the spatial domain image processing for the operations: contrast stretching, histogram equalization, image negation, thresholding, Smoothing (mean, Gaussian) and sharpening (Laplacian, high-boost) filters. Program to implement the Geometric transformations of the images Program to implement the Frequency domain processing: Fourier transform of the image, implementation of low-pass and high-pass filtering

Module - 3: Program to implement the techniques for detection of features from the image : Interest point detections, Corner, edge, and blob detection. Program to implement Scale-space and multi-scale feature extraction (SIFT, SURF) techniques for feature descriptors and invariance (rotation, scale, illumination), Program to implement the feature matching techniques RANSAC for robust estimation.
Module - 4: Program to implement the techniques for image segmentation (thresholding, region growing, graph cuts), Program to implement the clustering in vision (k-means, mean-shift, spectral clustering), Object detection frameworks (HOG, DPM, Viola–Jones), Object recognition pipelines, Program to implement the techniques for texture analysis and classification Scene categorization and semantic segmentation
Module - 5: Implement the eight-point algorithm to compute the fundamental matrix from point correspondences. Program to visualize epipolar lines on a pair of stereo images (draw corresponding epipolar lines). Camera Calibration and Pose Estimation: Use Zhang's method to calibrate a camera with a checkerboard pattern. Implement Lucas–Kanade method on a pair of consecutive frames (compute motion vectors for sparse feature points). Implement the deep learning model in the application form computer vision.

Text books:

1. Jan Erik Solem , Programming Computer Vision with Python, O'Reilly Media

2. Szeliski, Richard., Computer Vision: Algorithms and Applications., Springer, 2021. 2nd Ed.
3. Forsyth, D. A., and Jean Ponce. Computer Vision: A Modern Approach., Second Edition, Pearson Education, 2015.

Reference Books:

4. Simon J.D. Prince, Computer vision: models, learning and inference, Cambridge University Press.
5. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning., First Edition, MIT Press, 2016.
6. Gonzalez, Rafael C., Woods, Richard E. – Digital Image Processing, 4th ed., Pearson, 2018.
Sonka, Milan, Hlavac, Vaclav, Boyle, Roger – Image Processing, Analysis, and Machine Vision, Cengage,

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**

Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25425
Course Title	:	Parallel Computing Techniques
Pre-requisite(s)	:	Operating Systems; Computer Architecture
Co-requisite(s)	:	Computer Algorithms
Credits	:	03 L: 03 T: 00 P: 00
Class schedule/ week	:	03
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VII/4
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Introduce students to the principles and architectures of parallel computing.
B.	Provide knowledge of algorithm design techniques for parallel problem-solving.
C.	Familiarize students with widely used programming models and tools such as MPI and OpenMP.
D.	Develop the ability to analyze, evaluate, and optimize parallel program performance.
E.	Expose students to advanced topics and current trends in parallel computing, including GPUs and hybrid models.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand parallel architectures and performance issues.
CO2	Apply algorithm design techniques for parallelism.
CO3	Implement parallel programs using MPI and OpenMP.
CO4	Optimize and debug parallel applications.
CO5	Explore advanced topics including GPU and hybrid programming.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module - 1: Foundations of Parallel Computing (08 Lectures) Introduction to Parallel Computing: Motivation, historical development; Flynn's Taxonomy (SISD, SIMD, MISD, MIMD); Parallel computer architectures: Shared memory, Distributed memory, Hybrid models; Performance analysis: Speedup, efficiency, scalability; Laws of Parallel Computing: Amdahl's Law, Gustafson's Law	7
Module - 2: Principles of Parallel Algorithm Design (08 Lectures) Task and Data Parallelism; Decomposition strategies: Recursive, Data, Functional, Pipeline; Mapping and Load Balancing; Granularity and Communication Overhead; Case studies: Parallel Matrix Multiplication, Parallel Sorting Algorithms	7

Module - 3: Message Passing Programming (MPI) (08 Lectures) Message-Passing Model: Basics and programming principles; MPI Basics: Initialization, point-to-point communication (send/receive); Non-blocking communication and deadlocks; Collective Communication: Broadcast, Scatter, Gather, Reduce; Communicators and Derived Data Types; Case Studies: Matrix Operations, Parallel Reduction.	**7**
Module - 4: Shared Memory Programming (OpenMP) (08 Lectures) Shared Memory Model: Processes, threads, synchronization issues; OpenMP Basics: Parallel regions, Work-sharing constructs; Synchronization Constructs: Critical, Atomic, Barriers; Scheduling strategies: Static, Dynamic, Guided; Case Studies: Parallel Search, Parallel Loops, Image processing	**7**
Module - 5: Advanced Topics in Parallel Computing (08 Lectures) Performance Tuning and Debugging Parallel Programs; Memory Models and Cache Coherence; Parallel Programming on GPUs (CUDA basics); Hybrid Parallel Programming (MPI + OpenMP); Applications of Parallel Computing in Scientific Computing and Industry; Current Research Trends and Challenges in Parallel Systems	**7**

Text Books:

Michael J. Quinn, *Parallel Computing: Theory and Practice*, 2nd Edition, McGraw-Hill Education, 2004.

Reference Books:

Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, *Introduction to Parallel Computing*, 2nd Edition, Pearson Education, 2003.

Peter Pacheco, *Parallel Programming with MPI*, Morgan Kaufmann, 1997.

Beveridge, David and Dongarra, Jack J., *Numerical Methods for Parallel Computers*, Oxford University Press, 2001.

Wilkinson, Barry and Michael Allen, *Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers*, 2nd Edition, Pearson, 2005.

David Kirk and Wen-mei W. Hwu, *Programming Massively Parallel Processors: A Hands-on Approach*, 3rd Edition, Morgan Kaufmann, 2016.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, 2, 3, 4	CD1, CD2, CD3, CD8
CD2	Tutorials/Assignments	CO1, 2, 3, 4	CD1, CD2, CD3, CD8
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25426
Course Title	:	Parallel Computing Lab
Pre-requisite(s)	:	Operating Systems; Computer Architecture
Co-requisite(s)	:	Computer Algorithms
Credits	:	1.5 L: 00 T: 00 P: 03
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VII
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	**Understand fundamental concepts of parallel computing** through practical experiments on execution time, architectures, and programming models.
B.	**Develop skills in implementing parallel algorithms** using decomposition, load balancing, and synchronization techniques.
C.	**Apply parallel programming frameworks and libraries** such as MPI, OpenMP, and CUDA to solve computationally intensive problems.
D.	**Analyze performance metrics** (speedup, efficiency, scalability) to evaluate the effectiveness of parallel solutions.
E.	**Integrate hybrid programming paradigms** to address challenges in modern high-performance computing environments.

Course Outcomes

After the completion of this course, students will be able to:

CO1	**Demonstrate practical knowledge** of parallel computing concepts by implementing algorithms across different architectures (SISD, SIMD, MIMD).
CO2	**Design and implement parallel solutions** for matrix operations, sorting, searching, and reduction using appropriate decomposition strategies.
CO3	**Utilize MPI, OpenMP, and CUDA frameworks** to efficiently program distributed, shared memory, and GPU-based systems.
CO4	**Evaluate performance improvements** by measuring speedup, efficiency, and scalability of sequential vs. parallel solutions.
CO5	**Apply synchronization and hybrid programming techniques** to solve real-world computational problems on heterogeneous platforms.

SYLLABUS

List of Programmes and Assignments

1. **Lab Experiment 1:** Measure execution time of sequential vs. parallelizable code (e.g., array summation).
   Objective: Demonstrate speedup, efficiency, and Amdahl's Law.
2. **Experiment 2:** Simulate different architectures (SISD, SIMD, MIMD) using a small program.
   Objective: Understand Flynn's Taxonomy through coding examples.
3. **Experiment 3:** Implement **parallel matrix multiplication** using decomposition strategies.
   Objective: Study partitioning (row-wise, column-wise, block).

4. **Experiment 4:** Implement a **parallel sorting algorithm** (e.g., parallel merge sort or bitonic sort).
   Objective: Learn task decomposition and load balancing.
5. **Experiment 5:** Write an MPI program for **vector addition** using point-to-point communication.
   Objective: Learn basic MPI send/receive.
6. **Experiment 6:** Implement **parallel reduction (sum/maximum)** using collective communication.
   Objective: Use MPI collective operations like Reduce and Broadcast.
7. **Experiment 7:** Parallelize **matrix-vector multiplication** using OpenMP parallel loops.
   Objective: Apply #pragma omp parallel for.
8. **Experiment 8:** Implement a **parallel search** (e.g., binary search) with synchronization constructs.
   Objective: Use critical sections, atomic operations, and barriers.
9. **Experiment 9:** Implement **matrix multiplication using CUDA** (GPU programming).
   Objective: Learn CUDA basics — thread blocks, grids, memory usage.
10. **Experiment 10:** Develop a **hybrid MPI + OpenMP program** for matrix operations.
    Objective: Understand hybrid parallelism in modern HPC systems.

Text Books:
Michael J. Quinn, *Parallel Computing: Theory and Practice*, 2nd Edition, McGraw-Hill Education, 2004.

Reference Books:
Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, *Introduction to Parallel Computing*, 2nd Edition, Pearson Education, 2003.

Gaps in the Syllabus (to meet Industry/ Profession requirements)

POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, 2, 3, 4	CD1, CD2, CD3, CD8
CD2	Tutorials/Assignments	CO1, 2, 3, 4	CD1, CD2, CD3, CD8
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25411
Course Title	:	Business & Financial Analytics
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	3 L:3 T: 0 P:0
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VIII /4
Branch	:	AI & DS / AI & ML / CS

Course Objectives : This course enables the students to:

A.	Understand and articulate a business problem ●
B.	Apply Data visualization for exploratory analysis
C.	Evaluate various analytical approaches and select the most appropriate for the given problem
D.	Build Analytics solutions and assess their effectiveness;
E.	Communicate effectively to diverse audience

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

CO1	Students will learn the fundamentals & advancement of data analytics.
CO2	Demonstrate the ability to collect, prepare, and manage financial data from multiple sources and databases.
CO3	Apply data visualization and statistical tools to summarize and explore financial datasets for decision-making.
CO4	Develop predictive models (e.g., regression techniques) for financial analysis and evaluate their effectiveness.
CO5	Communicate analytical findings effectively through reports, presentations, and visual dashboards to stakeholders.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Introduction to Business Financial Analysis Introduction to Financial Analytics: Definition, relevance and scope Financial, Analytics, recent trends in financial Analytics, Role of financial analytics in business decision-making .Importance of financial data in strategy and planning, Key financial statements: Balance Sheet, Income Statement, Cash Flow Statement	8

Module – 2: Financial Databases, Measurement Scales, and Data Issues Financial databases and resources (Bloomberg, CMIE, CRISIL, World Bank, etc.), Categories of financial data: historical, real-time, structured, unstructured. Data quality issues in financial analysis (accuracy, timeliness, completeness), Aligning financial resources with organizational goals through analytics, Financial KPIs and metrics.	8
Module –3: Analytics Methodology Introduction to Analytics Methodology, preparing objectives & identifying data requirements, Data Collection, Understanding data, Data preparation – Data Cleansing, Normalization, Data preparation, Data Blending, Data Modelling, Evaluation & feedback, Visualization of Data	8
Module – 4: Visualization of Data Introduction, Data summarization methods; Tables, Graphs, Charts, Histograms, Frequency distributions, Relative Frequency Measures of Central Tendency and Dispersion; Box Plot; Basic probability concepts, conditional probability, Probability distributions, Continuous and discrete distributions, sequential decision making.	6
Module – 5: Predictive Analysis Simple linear regression: coefficient of determination, significance tests, residual analysis, confidence and prediction intervals. Multiple linear regression: coefficient of multiple coefficient of determination, interpretation of regression coefficients, categorical variables, heteroscedasticity, multicollinearity, outliers, autoregression and transformation of variables.	6

Text Books:

1. Ravi Shankar & D. Kumar, *Financial Analytics: A Practitioner's Guide*, Pearson, 2020.
2. Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, Wiley, 2012.
3. **James W. Evans, *Business Analytics*, Pearson, 2017 (selected chapters on financial data**

Reference Books:

1. David Ruppert & David S. Matteson, Statistics and Data Analysis for Financial Engineering, 3rd Edition, Springer, 2022.
2. Charles M. C. Lee & Eric C. So, Financial Statement Analysis and Security Valuation, 6th Edition, Cengage, 2019.
3. Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani, An Introduction to Statistical Learning with Applications in R and Python, 2nd Edition, Springer, 2021.

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	2	2	2	3	2	3	2	2	1	2	3	2	
CO2	2	3	3	2	2	3	3	3	2	2	2	2	2	2	
CO3	2	3	3	2	3	3	3	2	3	2	2	2	3	1	
CO4	1	2	3	2	2	3	2	2	3	2	1	1	3	2	
CO5	1	2	3	2	3	3	2	2	2	2	3	3	3	2	

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini-Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25412
Course Title	:	Business & Financial Analytics Lab
Pre-requisite(s)	:	
Co-requisite(s)	:	
Credits	:	1.5 L: 0 T: 0 P: 3
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VIII /4
Branch	:	AI & DS / AI & ML / CS

Course Objectives

This course enables the students to:

A.	Develop hands-on skills in analyzing business and financial data using R/Python.
B.	Apply statistical and computational techniques for decision-making.
C.	Gain experience with real-world datasets in business and finance
D.	Build predictive and descriptive models such as regression, hypothesis testing, and market basket analysis.
E.	Communicate insights effectively using visualization tools, reports, and dashboards for diverse stakeholders.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Import, handle, and explore real-world business and financial datasets using R/Python.
CO2	Perform preprocessing, data cleaning, and compute financial ratios from raw data.
CO3	Apply data visualization techniques to interpret and present financial insights
CO4	Use hypothesis testing and statistical techniques for business decision-making.
CO5	Build regression and market basket models to support predictive and prescriptive analytics.

SYLLABUS

Module - 1: Introduction & Data Handling

Import a company's financial statements (CSV/Excel).Load datasets using `pandas` (Python) / `read.csv()` (R).Summarize key statistics (mean, median, standard deviation).Explore financial datasets (e.g., stock data via `yfinance` in Python or `quantmod` in R).

Module - 2: Data Preprocessing Perform data cleaning and preprocessing operations (handling missing values, duplicates, outliers). Create financial ratios (Liquidity Ratio, Profitability Ratio, Leverage Ratio) from raw data.
Module - 3: Data Visualization Plot financial trends using line charts, bar charts, and histograms. Compare company performance using grouped plots. Build dashboards with matplotlib/seaborn (Python) or ggplot2 (R).
Module - 4: Hypothesis Testing: Test whether average sales before and after a marketing campaign are significantly different. T-tests, Chi-square tests for categorical variables. Apply statistical inference for financial/business decision-making.
Module - 5: Regression Analysis: Build a linear regression model: *Sales ~ Marketing Spend*. Interpret coefficients, R^2, and residuals. **Market Basket Analysis (Retail):** Apply Apriori algorithm on a transaction dataset. Generate association rules.

Text Books:

1. **James W. Evans, Business Analytics, 3rd Edition, Pearson, 2020**
2. **Wes McKinney, Python for Data Analysis, 3rd Edition, O'Reilly, 2022.**
3. **Hadley Wickham, R for Data Science, 2nd Edition, O'Reilly, 2023.**

Reference Books:

1. **Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani, An Introduction to Statistical Learning with Applications in R and Python, 2nd Edition, Springer, 2021.**
2. **David Ruppert & David S. Matteson, Statistics and Data Analysis for Financial Engineering, 3rd Edition, Springer, 2022.**
3. **Provost, F. & Fawcett, T., Data Science for Business, O'Reilly, 2013.**

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day-to-day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini-Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25413
Course Title	:	Digital Image Processing
Pre-requisite(s)	:	Engineering Mathematics, Algorithms
Co-requisite(s)	:	
Credits	:	3 L:3 T: 0 P:0
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VIII/4
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand image formation and the role human visual system plays in perception of grey and colour image data.
B.	To study the image fundamentals and mathematical transforms necessary for image processing.
C.	Describe various applications of image processing in various sectors like medical, defence, etc.
D.	Learn the signal processing algorithms and techniques in image enhancement and image restoration.
E.	Apply various image processing techniques to solve real world problems.

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

CO1	To understand basic concepts image processing, image storage and types of transformations that can be applied to images.
CO2	To compare the domains and methods of image processing.
CO3	Learn Image Restoration & Enhancement techniques, colour image processing.
CO4	Be able to make proper use of image processing tools.
CO5	Familiar with morphological image processing.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – 1 : Introduction and Digital Image Fundamentals: Digital Image Fundamentals, Human visual system, Image as a 2D data, Image representation – Gray scale and Color images, image sampling and quantization.	**5**
Module – 2 : Image enhancement in Spatial domain: Basic gray level Transformations, Histogram Processing Techniques, Histogram equalization, Histogram Matching, Spatial Filtering, Low pass filtering, High pass filtering, Mexican Hat Transformation, **Filtering in the Frequency Domain:** Introduction to the Fourier transform and frequency domain concepts, Extension to functions of two variables, low pass filter, high pass filter, Laplace transformation, Image Smoothing, Image Sharpening, Homo-morphic filtering.	**10**

Module – 3 : Image Restoration and Reconstruction: Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering. **Colour Image Processing:** Colour Fundamentals, Colour Models, Pseudo colour image processing.	**10**
Module – 4 : Image Compression: Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, Error free compression, Lossy compression. LZW coding, JPEG Compression standard.	**5**
Module – 5 : Morphological Image Processing: Erosion, dilation, opening, closing, Basic Morphological Algorithms: hole filling, connected components, thinning, skeletons.	**5**

Text Books:

1. **Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education**

Reference Books:

1. Milan Sonka, Vaclav Hlavav, Roger Boyle, ―Image Processing, Analysis and Machine Vision‖, 2nd ed., Thomson Learning, 2001
2. Pratt W.K, ―Digital Image Processing‖, 3rd ed., John Wiley & Sons, 2007
3. Digital Image Processing Using Matlab, Rafel C. Gonzalez and Richard E. Woods, Pearson Education
4. Fundamentals of Digital Image Processing by Anil K Jain, PHI

Gaps in the Syllabus (to meet Industry/ Profession requirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced Topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	**% Distribution**
First Quiz	10
Mid Semester Examination	25
Second Quiz/ Assignment/Seminar Presentation	10
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
Student Feedback on Faculty
Student Feedback on Course Outcome

Mapping between Course Outcomes and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

CorrelationLevels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code	:	SC25414
Course Title	:	Digital Image Processing Lab
Pre-requisite(s)	:	Engineering Mathematics, Algorithms
Co-requisite(s)	:	
Credits	:	1.5 L: 0 T: 0 P:3
Class schedule/ week	:	3
Class	:	B.Sc. (AI & DS / AI & ML / CS)
Semester/Level	:	VIII/4
Branch	:	AI & DS / AI & ML / CS

Course Objectives: This course enables the students to:

A.	Understand image formation and the role human visual system plays in perception of grey and colour image data.
B.	To study the image fundamentals and mathematical transforms necessary for image processing.
C.	Describe various applications of image processing in various sectors like medical, defence, etc.
D.	Learn the signal processing algorithms and techniques in image enhancement and image restoration.
E.	Apply various image processing techniques to solve real world problems.

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

CO1	To understand basic concepts image processing, image storage and types of transformations that can be applied to images.
CO2	To compare the domains and methods of image processing.
CO3	Learn Image Restoration & Enhancement techniques, colour image processing.
CO4	Be able to make proper use of image processing tools.
CO5	Familiar with morphological image processing.

SYLLABUS

1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)
2. Implementation of Relationships between Pixels
3. Implementation of Transformations of an Image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
5. Display of bit planes of an Image
6. Display of FFT (1-D & 2-D) of an image
7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
8. Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)
9. Implementation of image sharpening filters and Edge Detection using Gradient Filters
10. Image Compression by DCT, DPCM, HUFFMAN coding
11. Implementation of image restoring techniques
12. Implementation of Image Intensity slicing technique for image enhancement
13. Canny edge detection Algorithm

Text Books:

1. **Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education**

Reference Books:

1. Milan Sonka, Vaclav Hlavav, Roger Boyle, ―Image Processing, Analysis and Machine Vision‖, 2nd ed., Thomson Learning, 2001
2. Pratt W.K, ―Digital Image Processing‖, 3rd ed., John Wiley & Sons, 2007
3. Digital Image Processing Using MATLAB, Rafel C. Gonzalez and Richard E. Woods, Pearson

Education

4. Fundamentals of Digital Image Processing by Anil K Jain, PHI

Gaps in the Syllabus (to meet Industry/ Profession reuirements)
POs met through Gaps in the Syllabus:
Topics beyond the syllabus/ Advanced topics/ Design:
POs met through Topics beyond the syllabus/ Advanced topics/ Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance and Lab File	30
Quiz	10
Viva Voce	20
Semester End Examination	**% Distribution**
Examination/ Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	20%	20%	20%	20%	20%
Semester End Examination	20%	20%	20%	20%	20%

Mapping between Cos and Program Outcomes

Course outcome	**Program Outcomes (POs)**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between Cos and Course Delivery (CD) methods

CD Code	**Course Delivery Methods**	**Course Outcome**	**Course Delivery Method Used**
CD1	Lecture by use of Boards/ LCD Projectors	CO1	CD1,CD8
CD2	Tutorials/Assignments	CO2	CD1,CD8,CD9
CD3	Seminars	CO3	CD1,CD2,CD5
CD4	Mini Projects/Projects	CO4	CD1,CD5,CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1,CD2,CD9
CD6	Industrial/ Guest Lectures		
CD7	Industrial Visits/ In-plant Training		
CD8	Self-learning such as use of PTEL Materials and Internets		
CD9	Simulation		