SAHYADRI
COLLEGE OF ENGINEERING & MANAGEMENT
An Autonomous Institution
MANGALURU

COMPUTATIONAL DISCRETE MATHEMATICS

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BMA301TC	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40 L	Exam Hours	3 Hours

CREDITS – 3

COURSE PREREQUISITES:

- Basics of Permutation, combination and Set theory

COURSE OBJECTIVES:

This course will enable students to:

- Enable the students to apply basic concepts of Logic on developing algorithms.
- Understand the Principle of Inclusion and Exclusion in solving combinatorial counting problems.
- Develop a strong conceptual understanding of relations and functions, enabling their application in computer science.
- Apply the knowledge of modular arithmetic to computer algorithms and to learn about vector spaces.

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Fundamentals of Logic and Properties of the Integers **Fundamentals of Logic**: Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. Quantifiers, Logical implication involving Quantifiers and Methods of the Proof and Disproof. **Properties of the Integers** : The Well Ordering Principle–Mathematical Induction.	**8 Hours**

MODULE II

Principles of Counting **Fundamental Principles of Counting:** The Rules of Sum and Product, Permutations, Combinations, Combinations with Repetition. **The Principle of Inclusion and Exclusion**: The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements–Nothing is in its Right Place, Rook Polynomials.	**8 Hours**
MODULE III	
Relations, Functions and Recurrence Relations **Relations and Functions**: Cartesian Products and Relations, Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders–Hasse Diagrams, Equivalence Relations and Partitions. Functions, Properties of functions, Composition of functions and Inverse Functions, The Pigeon-hole Principle. **Recurrence Relations:** First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients.	**12 Hours**
MODULE IV	
Modular Arithmetic and Vector Spaces **Modular Arithmetic:** Introduction to Congruence, Linear Congruence, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruence, Euler's Theorem, Wilson Theorem and Fermat's little theorem. **Vector Spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Problems.	**12 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Apply Logic principles and Quantifiers to solve complex problems in computer science.	CL3
CO2	Demonstrate proficiency in combinatorial analysis to apply counting techniques to solve diverse combinatorial problems, demonstrating advanced analytical and problem-solving skills.	CL3
CO3	Develop understanding of relations and functions to apply on data modelling and optimization of algorithms.	CL3
CO4	Apply modular arithmetic to computer algorithms and demonstrate the idea of linear dependence and independence of sets in the vector space.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks

1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus Coverage			**Syllabus Coverage**	**Syllabus Coverage**
40%	**30%**	**30%**	**100%**	**100%**
MI			MI	MI
MII	MII		MII	MII
	MIII	MIII	MIII	MIII
		MIV	MIV	MIV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. RalphP.Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition,Pearson Education.2004.
2. Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach,Universities Press, 2016
3. Kenneth H.Rosen: Discrete Mathematics and its Applications, 6th Edition,McGrawHill, 2007.
4. Jayant Ganguly: A Treatise on Discrete Mathematical Structures, Sanguine-Pearson, 2010.
5. D.S.Malik and M.K.Sen: Discrete Mathematical Structures: Theory and Applications, Thomson, 2004.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://www.youtube.com/watch?v=8Kg21jBCm-k
2. https://www.youtube.com/watch?v=Wa6kaCwyYRk
3. http://nptel.ac.in/courses.php?disciplineID=111
4. http://www.class-central.com/subject/math(MOOCs)
5. http://academicearth.org/
6. http://www.bookstreet.in.

SAHYADRI
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DIGITAL LOGIC DESIGN AND COMPUTER ORGANIZATION

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BIS302G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Basic knowledge of number systems and computer components.

COURSE OBJECTIVES:

This course will enable students to:

- Illustrate combinational digital circuits.
- Demonstrate the use of flip-flops and apply to registers and counters.
- Explain the basic subsystems of a computer, their organization, structure, and operation.
- Describe the memory hierarchy and concept of cache memory.
- Describe arithmetic and logical operations with integer operands.
- Demonstrate different ways of communicating with I/O devices and standard I/O interfaces.
- Illustrate the organization of a simple processor and other computing systems using instruction-level parallelism.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Combinational Logic design: Karnaugh Map**,** Minimization of complete and incomplete Boolean expressions using K-Map, Multiplexers, Three-state buffers, Decoders and Encoders, Programmable Logic devices.	**10 Hours**

MODULE II

Sequential Logic Design: Flip-Flops and its Applications**,** Master Slave Flip-Flops, Edge-Triggered Flip-Flops, Registers, Counters, Design of Synchronous Counters. **Introduction to VHDL**: VHDL description of combinational circuits, VHDL Models for multiplexers, VHDL Modules.	**10 Hours**
MODULE III	
Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **Machine Instructions and Addressing Modes:** Memory Location and Addresses, Instructions and Instruction Sequencing, Addressing Modes **Input/Output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits.	**10 Hours**
MODULE IV	
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Hard-wired Control, Micro programmed Control. **Memory System:** Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations. **Arithmetic:** Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers.	**10 Hours**

COURSE OUTCOMES

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

CO1	Construct simplified Boolean expressions and combinational circuits using Karnaugh Maps, multiplexers, decoders, and programmable logic devices.	CL3
CO2	Implement sequential logic systems using various types of flip-flops, registers, and synchronous counters, and develop VHDL models to simulate the behavior of combinational and sequential digital circuits.	CL3
CO3	Analyze the structure and functioning of computer systems by examining processor operations.	CL3
CO4	Apply knowledge of I/O mechanisms, control units, and addressing modes to demonstrate instruction execution flow.	CL3

LABORATORY COMPONENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Design and implement Half adder, Half subtractor, Full adder, and Full Subtractor using basic gates.	CL3
2.	Design and implement a code converter I) Binary to Gray, II) Gray to Binary Code	CL3

3.	Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC.	CL3
4.	Realize a J-K Master / Slave Flip-Flop using NAND gates and verify its truth table.	CL3
5.	Design and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.	CL3
6.	Design and implement an asynchronous counter using decade counter IC to count up from 0 to n (n<=9) and demonstrate on 7-segment display.	CL3
7.	Design and simulate a 4x4 RAM.	CL3
8.	Design and realization of a 16-bit ALU (Arithmetic Logic Unit).	CL3
9.	Design and simulate Booth's Multiplier to multiply two signed integers.	CL3
10.	Synthesis of Combinational Multipliers to multiply two 4-bit binary numbers.	CL3
11.	Using ua 741 opamp, design a Schmitt trigger for any given UTP and LTP.	CL3
12.	Design an astable multivibrator circuit for three cases of duty cycle (50%, 50%) using NE 555 timer IC.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (30%)			**Assignment (20%)**	**Practical (50%)**	
I	**II**	**III**			
Syllabus Coverage			**Syllabus Coverage**		**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**	**100%**
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.

- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode:

- The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)
- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE, is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)

- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Charles H Roth and Larry L Kinney, Analog and Digital Electronics, Cengage Learning,2019.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw-Hill, 2002.
3. Digital Principles and Design, Donald D. Givone, 1st Edition, 2002, Tata McGraw-Hill Publishers.
4. Computer Organization And Architecture Designing For Performance, William Stallings 11th Edition, 2019, Pearson.
5. Logic and Computer Design Fundamentals, M. Morris Mano Charles Kime, 4th Edition 2014, Pearson.
6. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008
7. Digital Design and Computer Architecture, David M Harris, Sarah L Harris, 2nd Edition, 2013, Elsevier Morgan Kaufmann Publishers.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://nptel.ac.in/courses/108/105/108105132/
2. https://nptel.ac.in/content/storage2/courses/106103068/pdf/coa.pdf
3. https://nptel.ac.in/courses/106/105/106105163/
4. https://nptel.ac.in/courses/106/106/106106092/
5. https://nptel.ac.in/courses/106/106/106106166/
6. http://www.nptelvideos.in/2012/11/computer-organization.html
7. http://vlabs.iitkgp.ac.in/coa/index.html
8. http://vlabs.iitkgp.ac.in/dec

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OBJECT ORIENTED PROGRAMMING USING JAVA

(Effective from the Academic Year 2025 - 2026)

III SEMESTER

Course Code:	BIS303G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamental knowledge of C programming.

COURSE OBJECTIVES:

This course will enable students to:

- Learn fundamental Object-Oriented features of C++ and Java, classes, objects and its methods.
- Set up a Java JDK environment to create, debug, and run simple Java programs.
- Explore the concepts of Inheritance, Packages, and Interfaces.
- Discover the use of Java built-in exception-handling mechanisms.
- Create Multi-threaded programs, Event handling, and Swing programs.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Java: Java's magic: the Byte code, Java Development Kit (JDK), The Java Buzzwords, Object-oriented programming, Simple Java programs. Data types, variables and arrays, Operators, Control Statements.	**10 Hours**

MODULE II

Classes, Inheritance, Exceptions, Packages, and Interfaces: Classes: Classes fundamentals; Declaring objects; Constructors, this keyword, garbage collection.	**10 Hours**

Inheritance: Inheritance basics, using super, creating multi-level hierarchy, method overriding. **Exception handling:** Exception handling in Java. Packages, Access Protection, Importing Packages, Interfaces.	

MODULE III	
Multi-Threaded Programming: Multi-Threaded Programming: What are threads? How to make the classes threadable; Extending threads; Implementing runnable; Synchronization; Changing state of the thread; Bounded buffer problems, producer consumer problems, Interthread Communications. **The Applet Class:** Two types of Applets; Applet Basics: Applet Architecture; An Applet Skeleton; Simple Applet display methods.	**10 Hours**

MODULE IV	
Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes; Inner classes. **Swings:** The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application.	**10 Hours**

COURSE OUTCOMES

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

CO1	Interpret basic Java concepts and write simple programs.	CL2
CO2	Apply OOP concepts using classes, inheritance, and exceptions.	CL3
CO3	Develop multi-threaded programs and simple applets.	CL3
CO4	Build GUI applications using event handling and Swing.	CL3

LABORATORY CONTENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Implement a Java Program to illustrate the concept of operators.	CL3
2.	Demonstrate the for, for-each, while and do-while loops using a Java Program.	CL3
3.	Write a Java Program for demonstrating creation of Java classes, objects, declaration and initialization of variables.	CL3
4.	Implement a Java Program to illustrate the concept of Inheritance and polymorphism.	CL3
5.	Implement a Java Program to illustrate Class, Object, and Constructors for Student Information Management.	CL3
6.	Develop a Java Program to create Java package and illustrate the process of importing a user defined Java Package.	CL3

7.	Implement a Java Program to demonstrate Bounded buffer problems using Java Multi-Threading concepts.	CL3
8.	Implement a Java Program to demonstrate producer-consumer problem.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE respectively.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10

8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode:

- The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)
- In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE exam is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, the Question 1 shall be mandatory and can have any number of sub-questions each of 01-03 marks totaling to 20 covering all five modules
- In Part B, a student has to answer 4 FULL questions where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain choice i.e. 4A or 4B. Each question may contain a maximum of three sub questions (i.e. 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain choice i.e. 5A or 5B. Each question may contain a maximum of three sub questions (i.e. 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE into the appropriate modules

REFERENCE BOOKS:

1. Sourav Sahay, Object Oriented Programming with C++, 2nd Ed, Oxford University Press,2006
2. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007.
3. E Balagurusamy, Programming with Java, McGraw Hill, 6th Edition, 2019.
4. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc22_cs102/

2. https://www.geeksforgeeks.org

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DATA STRUCTURES AND APPLICATIONS

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BIS304T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Mathematics and C Programming

COURSE OBJECTIVES:

This course will enable students to:

- Explain the fundamental knowledge of various types of data structures and their applications essential for implementing solutions to problems.
- Implement linear data structures stacks, queues, and usage of stacks in various applications.
- Implement the operations of singly linked lists and circular linked lists, doubly linked list, and circular doubly lists.
- Identify and differentiate different types of binary trees and binary search trees data structures, and also implement threaded binary trees, expression trees, and AVL trees.
- Illustrate representations and implementations of various nonlinear data structures, and Hashing.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Data Structures: Classifications, Data structure Operations, Demonstration of Sparse Matrices with arrays, String Pattern Matching Algorithms. **Stack:** Concepts and Operations, Array Representation of Stacks, Stacks using Dynamic Arrays.	**10 Hours**

Applications of Stack: Infix to Postfix Conversion, Evaluation of Postfix expression, Recursion: Ackermann function. **Queues:** Introduction to Queues, Array and Linked Representation of Queues, Operations on Queues, Circular Queues Operations, Circular Queues using Dynamic arrays, Dequeues, Priority Queues. **Applications of Queues:** Job Scheduling.	
MODULE II	
Linked List: Introduction to Linked Lists, Representation of linked lists in Memory, Dynamic Memory allocation functions, Singly Linked list Operations: Traversing, Searching, Insertion and Deletion, Header linked lists, Doubly Linked lists Operations, Circular linked lists, Linked Stacks and Queues. **Applications of Linked Lists:** Polynomials, Sparse matrix representation.	**10 Hours**
MODULE III	
Trees: Terminologies, Binary Trees, Properties of Binary Trees, Array and linked representation of Binary Trees, Binary Tree Traversals, Threaded binary trees, Binary Search Trees: Definition, Insertion, Deletion, Traversal, Searching, AVL tree. **Application of Trees:** Evaluation of Arithmetic Expression.	**10 Hours**
MODULE IV	
Graphs: Terminologies, Graph representations, Traversal methods: Breadth First Search and Depth First Search. **Hashing:** Introduction, Hash Table organizations, Hashing Functions, Static and Dynamic Hashing	**10 Hours**

COURSE OUTCOMES

CO1	Apply the fundamental concepts of arrays, stacks, and queues to solve real-world problems.	CL3
CO2	Develop and illustrate the various operations of singly linked lists, doubly linked lists, and circular linked lists.	CL3
CO3	Make use of a tree data structure with different traversal methods to evaluate an arithmetic expression.	CL3
CO4	Identify the different traversal methods in a graph and show the usage of hashing techniques.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)	Semester End Exam (SEE) (50%)

Continuous Internal Evaluation (CIE) (60%)			Assignment/ Activities (40%)	
I	II	III		
Syllabus coverage			Syllabus Coverage	Syllabus Coverage
35%	35%	30%	100%	100%
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  - e. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  - f. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  - g. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  - h. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed., Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw-Hill, 2014.
3. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
4. Reema Thareja, Data Structures using C, 3rd Ed, Oxford Press, 2012.
5. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed., McGraw-Hill, 2013.
6. A M Tenenbaum, Data Structures using C, PHI, 1989.
7. Robert Kruse, Data Structures and Program Design in C, 2nd Ed., PHI, 1996.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
2. https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
3. https://nptel.ac.in/courses/106/102/106102064
4. https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
5. https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
6. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
7. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html

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DATA STRUCTURES LABORATORY WITH C

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BIS305L	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Basic Maths and Fundamentals of C Programming.
- Usage of IDEs like NetBeans.

COURSE OBJECTIVES:

This course will enable students :

- To get practical experience in design, develop, implement, analyze, and testing various algorithms.
- To visualize and understand linear/nonlinear data structures with their applications, such as Stack, Queues, Linked List, Trees, Graphs, and Hashing.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PRE-REQUISITE EXPERIMENTS

Exp. No.	Description
1.	Write a C Program to read and print N student records (record should contain Name, roll number, marks) using structures.
2.	Write a C program to demonstrate the working of string comparison, string concatenation, and string reversal.
3.	Write a C program to find the sum, mean, and standard deviation of an array elements using pointer.

LIST OF EXPERIMENTS

Exp. No.	Description

1.	Design and implement a program in C on Frequency Histogram, which builds a frequency array for data values in the range 1 to n and then prints their histogram. The program should, a. Read, Store, and print the data in an array. b. Analyze the data in the array, one element at a time. Add 1 to the corresponding element in a frequency array based on the data value. c. Print a histogram using asterisks for each occurrence of an element.
2.	Design and implement a program in C for the following Stack Applications, a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Conversion of Arithmetic Expressions
3.	Design and implement a menu-driven Program in C for the following operations on a Circular QUEUE of Characters, a. Insert an Element into a Circular QUEUE b. Delete an Element from a Circular QUEUE c. Demonstrate Overflow and Underflow situations on a Circular QUEUE d. Display the status of the Circular QUEUE
4.	Design, develop, and implement a menu-driven Program in C for the following operations on a Singly Linked List (SLL) of Employee Data with the fields: EmpID, Name, Designation, Branch, PhNo. a. Create an SLL of N Students' Data by using front insertion b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at the End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack)
5.	Design and implement a menu-driven program in C for the following operations on a Doubly Linked List (DLL) of Student Data with the fields: USN, Name, Department, Marks, Ph.No. a. Create a DLL of N Students' Data by using end insertion. b. Display the status of the DLL and count the number of nodes in it c. Perform Insertion and Deletion at the End of the DLL d. Perform Insertion and Deletion at the Front of the DLL e. Display the total and average marks for each student
6.	Design and implement a program in C for the following operations on a Singly Circular Linked List (SCLL) with header nodes, a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2y2z - 4yz5 + 3x3yz + 2xy5z - 2xyz3. b. Find the sum of two polynomials, POLY1(x,y,z) and POLY2(x,y,z), and store the result in POLYSUM(x,y,z).
8.	Design, develop, and implement a menu-driven Program in C for the following operations on a Binary Search Tree (BST) of Integers a. Create a BST of N Integers b. Traverse the BST in Inorder, Preorder, and Post Order c. Search the BST for a given element (KEY) and report the appropriate message

9.	A company has seven top officers working for it. They are each fluent in at least one language, according to the following sample table,

Officer	Hindi	Malayalam	Kannada	Telugu
01	-	-	Y	-
02	-	-	Y	Y
03	-	-	-	Y
04	-	Y	-	Y
05	Y	Y	-	-
06	Y	-	Y	-
07	-	Y	-	-

Design and implement a program in C for the following operations on Graphs (G),

a. Create a graph using an adjacency matrix indicating people who can communicate directly with each other.
b. Print all the officers that are reachable from a given officer as a starting node in a digraph.

Example: An officer wants to send a message to another officer. A message comes to an officer, he reads it and transmits it to another officer, possibly after translation to someone who has not read it.

10.	Design and implement a program in C that uses the Hash Function H: K->L as H(K)=K mod m(remainder method), and implement a hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

COURSE OUTCOMES

CO1	Design and implement array, stack, and queue data structures for a given application.	CL3
CO2	Design and implement the concepts of DLL and SCLL.	CL3
CO3	Utilize the concepts of trees and graphs to solve real-world problems.	CL3
CO4	Illustrate the application of hashing techniques to analyze the collision problems and develop suitable functions to resolve collisions.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

I. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE exam, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

II. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

SUGGESTED LEARNING RESOURCES:

BOOKS:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed., Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw-Hill, 2014.
3. Gilberg and Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning, 2014.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
2. https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
3. https://nptel.ac.in/courses/106/102/106102064
4. https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
5. https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
6. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
7. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html

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PROMPT ENGINEERING

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BIS306W1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Python Fundamentals, Logical and Critical Thinking

COURSE OBJECTIVES:

This course will enable students to:

- Understand the fundamentals of natural language processing and outline the importance of Large Language Models (LLMs).
- Design and Implement Prompting Strategies
- Critically Evaluate LLM Methodologies and Outputs
- Identify and Mitigate Adversarial Risks
- Leverage LLMs for Code and Data Generation

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Fundamentals of Natural Language Processing using Python: Regex in Python, Finding Patterns of Text with Regular Expressions, Creating Regex Objects, Matching Regex Objects, Grouping with Parentheses, Matching Multiple Groups with the Pipe, Optional Matching with the Question Mark, Matching Zero or More with the Star, Matching One or More with the Plus, Matching Specific Repetitions with Braces, Greedy and	**10 Hours**

Non-greedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Matching Everything with Dot-Star, Matching Newlines with the Dot Character, Substituting Strings with the sub() Method, Managing Complex Regexes Getting Started With Python's NLTK, Tokenizing, Filtering Stop Words, Stemming, Tagging Parts of Speech, Lemmatizing, Chunking, Chinking, Named Entity Recognition (NER), Getting Text to Analyze, Using a Concordance, Making a Dispersion Plot, Making a Frequency Distribution, Finding Collocations **Introduction to Large Language Models (LLM):** What are Large Language Models?, Importance of LLMs, Human Thought vs LLM Processing, How LLMs See the World, Temperatures and Probabilities, Transformer Architecture	
MODULE II	
Mastering Prompts: Basics of Prompting, Prompt Formatting, Prompt Elements, General Tips for Designing Prompts: The Instruction, Specificity, Avoiding Impreciseness. Examples of Prompts: Text Summarization, Information Extraction, Question Answering, Text Classification, Conversation, Code Generation **Advanced Prompting Strategies:** Zero-Shot Prompting, Few-Shot Prompting, Chain-of-Thought Prompting, Self-Consistency, Generate Knowledge Prompting, Tree of Thoughts (ToT), Retrieval Augmented Generation (RAG), Automatic Reasoning and Tool-use (ART), Automatic Prompt Engineer, Active-Prompt, Directional Stimulus Prompting, ReAct Prompting, Multimodal CoT Prompting, Graph Prompting.	**10 Hours**
MODULE III	
Adversarial Prompting: Adversarial Prompting: Prompt Injection, Prompt Leaking, Jail breaking, Illegal Behavior, Do Anything Now (DAN), The Waluigi effect, Defense Tactics, Add Defense in the Instruction, Parameterizing Prompt Components, Quotes and Additional Formatting, Adversarial Prompt Detector, Factuality, Biases: Distribution of Exemplars, Order of Exemplars.	**10 Hours**
MODULE IV	
Development with Program-Aided Language Models and AI-Powered Tools: Program-Aided Language Models, Generating Data, Generating Code, Turn Comments into Code, Complete Functions, MySQL Query Generation, Explain Code, Editing Code, Debugging Code. Tools: AI Test Kitchen, ChatGPT Prompt Generator, DreamStudio, OpenAI Playground, Visual Prompt Builder.	**10 Hours**

COURSE OUTCOMES

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

CO1	Apply core NLP techniques and explain the foundational concepts of Large Language Models.	CL3
CO2	Summarize how prompt engineering aligns with specific requirements and categorize various prompt engineering techniques.	CL3
CO3	Identify the potential risks and misuse scenarios in prompt engineering through relevant case studies.	CL3
CO4	Explore different applications and tools within the field of prompt engineering.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,

a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, ISBN: 9781098153373, O'Reilly Media, Inc., 2024
2. "Automate the Boring Stuff with Python", 3rd edition, by Al Sweigart, published by No Starch Press.
3. Natural Language Processing with Python, Steven Bird, Ewan Klein, Edward Loper, O'Reilly Media, Inc.
4. The Art of Prompt Engineering with ChatGPT: A Hands-On Guide, Nathan Hunter, 2023

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.promptingguide.ai/
2. https://automatetheboringstuff.com/
3. https://pythontutor.com/
4. https://openai.com/blog/chatgpt
5. Prompt Engineering Overview
6. https://realpython.com/nltk-nlp-python/
7. https://www.scaler.com/topics/nlp/nltk-in-nlp-python

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ETHICAL HACKING AND CYBER SECURITY

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BIS306W2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Familiarity with scripting languages such as Python
- Networking Fundamentals
- Basic knowledge of cybersecurity principles

COURSE OBJECTIVES:

This course will enable students to:

- Understand ethical hacking, penetration testing, and physical security.
- Familiar with Penetration Testing and Tools.
- Get an exposure to the Metasploit exploitation tool.
- Learn about common types of malware, Trojans, backdoors, spyware, ransomware, and sniffers.
- Study various incident response and defensive technologies.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Ethics of Ethical Hacking: Why You Need to Understand Your Enemy's Tactics, Recognizing the Gray Areas in Security, Vulnerability Assessment and Penetration Testing.	**10 Hours**

Penetration Testing and Tools: Social Engineering Attacks: How a Social Engineering Attack Works, conducting a Social Engineering Attack, Common Attacks Used in Penetration Testing, Preparing Yourself for Face-to-Face Attacks, Defending Against Social Engineering Attacks.	

MODULE II

Physical Penetration Attacks: Need of Physical Penetration, conducting a Physical Penetration, Common Ways into a Building, Defending Against Physical Penetrations. **Insider Attacks:** Conducting an Insider Attack, Defending Against Insider Attacks. **Metasploit:** The Big Picture, Getting Metasploit, Using the Metasploit Console to Launch Exploits, Exploiting Client-Side Vulnerabilities with Metasploit, Penetration Testing with Metasploit's Meterpreter, Automating and Scripting Metasploit, Going Further with Metasploit.	**10 Hours**

MODULE III

Malware: Malware, Viruses and How they Function, Worms and How they Function, Significance of Trojans, Detection of Trojans and Viruses, Trojan Tools, Distribution Methods, Trojan Construction Kits, Backdoors, Covert Communication, Spyware, Adware, Scareware, Ransomware. Sniffers, Session Hijacking, and Denial of Service Attacks: Sniffers, Session Hijacking, Distributed Denial of Service (DDoS) Attacks, Botnets and the Internet of Things (IoT).	**10 Hours**

MODULE IV

Incident Response: What is Security Incident? The Incident Response Process, Incident Response Plans, Planning for Disaster and Recovery, Evidence Handling and Administration, Requirements of Regulated Industries. Defensive Technologies: Defense in Depth, Intrusion Detection Systems, The Purpose of Firewalls, Honeypots / Honeynets, The Role of Controls, Security Best Practices.	**10 Hours**

COURSE OUTCOMES

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

CO1	Explain the principles of ethical hacking and differentiate between vulnerability assessment and penetration testing using real-world scenarios.	**CL2**
CO2	Demonstrate various physical and insider attack techniques and utilize Metasploit tools for simulating penetration testing and client-side exploits.	**CL3**
CO3	Describe types of malware and demonstrate basic sniffing, session hijacking, and denial of service techniques.	**CL3**
CO4	Outline the steps in incident response and use basic defensive technologies such as firewalls, IDS, and honeypots.	**CL3**

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**

	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**

- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Sean-Philip Oriyano, Michael G Solomon "Hacker Techniques, Tools, and Incident Systems", Third Edition, Jones & Bartlett Learning, 2020.
2. Gray Hat Hacking - The Ethical Hackers Handbook, Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams, 3rd Edition, Tata McGraw-Hill.
3. Abhinav Ojha, "Beginners Guide to Ethical Hacking and Cyber Security", Notion Press, 2020.
4. Hugo Hoffman, "Ethical Hacking with Kali Linux - Learn Fast how to Hack like a Pro", 2020.
5. The Web Application Hacker's Hand Book - Discovering and Exploiting Security flaws, Dafydd Suttard, Marcuspinto,1st Edition, Wiley Publishing.
6. Penetration Testing: Hands-on Introduction to Hacking, Georgia Weidman, 1st Edition, No Starch Press.
7. The Pen Tester Blueprint - Starting a Career as an Ethical Hacker, L. Wylie, Kim Crawly,1st Edition, Wiley Publications.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.techtarget.com/whatis/feature/17-free-cybersecurity-tools-you-should-know-about
2. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks
3. https://www.youtube.com/watch?v=mOOIv8-IuEo
4. https://www.youtube.com/watch?v=R0up9SZJqyQ
5. https://archive.nptel.ac.in/courses/106/105/106105217/
6. https://www.youtube.com/watch?v=fgdcE4kfQBc
7. https://www.youtube.com/watch?v=bQh-nhhYcS4
8. https://www.youtube.com/watch?v=i5GLg9XWJg4
9. https://ieeexplore.ieee.org/document/8463920
10. https://qualysec.com/penetration-testing-and-vulnerability-assessment/

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LINUX SYSTEM PROGRAMMING

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BIS306W3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Foundational of C programming, data structures and computer organization.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce the fundamental concepts and architecture of Unix operating systems, including the kernel, shell, file system, and process management.
- Familiarize with Unix system calls for performing low-level file operations, process control, signal handling, and inter-process communication (IPC).
- Equip the students with control structures in shell scripting and introduce AWK programming.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Getting Started & Understanding LINUX Commands: LINUX Operating System, LINUX architecture, Features of LINUX, The POSIX Standards, API Common Characteristics. **General Purpose Utilities:** passwd, who, tty, lock, sty, script, clear and tput, uname, date, cal, calendar, bc, man, echo, script, passwd, uname, who, date. Case study/ Applications	**10 Hours**

MODULE II

File System And Attributes: Introduction to LINUX file system, inode, FileTypes, File Attributes,	**10 Hours**

Application program Interface to Files, LINUX kernel support for files **File Handling Commands**: ls, cat, cp, mv, rm, wc, od, printf, pwd, mkdir, rmdir, cd, file and directory permissionschmod, file ownership- chown,chgrp, umask, tar. **Process:** Process, LINUX kernel support for processes, process attributes, process table, viewing processes – ps, system processes, starting new processes, waiting for a process, zombie processes, orphan process, fork, vfork, exit, wait, waitpid, exec .	

MODULE III

Networking Commands: ifconfig ,ulimit , finger, arp, ftp, telnet, hostname, traceroute, ping, netstat, ns lookup **Inter Process Communication:** Pipe, process pipes, pipe call, Named Pipes–FIFO, Message Queues–msgget, msgsnd, msgrcv, msgctl	**10 Hours**

MODULE IV

Shell Programming : Shell variables, shell scripts, read, positional parameters ,exit status, logical operators, exit, if conditions, test and[],case, expr, sleep and wait, while and for. **AWK Programming:** Splitting line into fields, printf –formatting output, comparison operators, number processing, BEGIN and END section, positional parameters, get line, built in variables and functions.	**10 Hours**

COURSE OUTCOMES

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

CO1	Explain the fundamentals of Multi-User Operating system and commands	CL2
CO2	Apply the file manipulation commands and analyze the mechanism of process creation.	CL4
CO3	Apply the networking commands and IPC mechanism.	CL3
CO4	Execute shell scripts and evaluate awk programs for various real-time applications.	CL4

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**

35%	35%	30%	100%	100%
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

The question paper will have **TWO** parts viz. **Part A (20 Marks)** and **Part B (80 Marks)**

- In Part A, the Question 1 shall be mandatory and can have any number of sub-questions each of 01-03 marks totaling to 20 covering all four modules
- In Part B, a student has to answer 4 FULL questions where,
  - e. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub questions
  - f. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub questions
  - g. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain choice i.e. 4A or 4B. Each question may contain a maximum of three sub questions (i.e. 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  - h. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain choice i.e. 5A or 5B. Each question may contain a maximum of three sub questions (i.e. 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

8. Linux for Beginners: A Practical and Comprehensive Guide to Learn Linux, Ethem Mining, ISBN: 978-1671228085, 2019.

9. Your UNIX – The ultimate Guide, SUMITABHA DAS, TATA McGraw Hill Edition, 4th Edition Paper back 2017, McGraw Hill, ISBN:978-0070446878
10. UNIX System Programming Using C++, Terrence Chan, Prentice-Hall of India Private Limited, ISBN:978-9332549975,2015.
11. Advanced Programming in the UNIX Environment, WRichard Stevens and Stephen A Rago, Addison Wesley Publications, Third Edition,2013,ISBN:978-0321637734.
12. UNIX and SHELL Programming, Richard F Gilberg and Behrouz A Forouzan, 15th impression, 2015, Cengage Learning, ISBN : 978-8131503256

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://nptel.ac.in/courses/117106113
2. https://web.njit.edu/~alexg/courses/cs332/OLD/F2020/hand3f20/Linux-Tutorial.pdf
3. https://www.youtube.com/watch?v=8lwxOAecpLQ

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COMPUTER GRAPHICS AND VISUALIZATION

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BIS306W4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Data Structures and Algorithms

COURSE OBJECTIVES:

This course will enable students to:

- Explain hardware, software, and OpenGL Graphics Primitives.
- Illustrate interactive computer graphics using OpenGL.
- Design and implementation of algorithms for 2D and 3D graphics Primitives and attributes.
- Discuss the relationship between classical and computer viewing.
- Apply concepts of visible surface detection in 2D and 3D viewing, and infer Illumination Models.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Graphics Systems and Models: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging Systems; The synthetic camera model; The programmer's interface; Graphics architectures; Programmable Pipelines; Performance Characteristics. **Graphics Programming:** The Sierpinski gasket; Programming Two-Dimensional Applications.	**10 Hours**

MODULE II

The OpenGL: The OpenGL API; Primitives and attributes; Color; Viewing; Control functions; The Gasket program; Polygons and recursion; The three-dimensional gasket; Plotting Implicit Functions.	**10 Hours**

MODULE III

Input and Interaction: Interaction; Input devices; Clients and Servers; Display Lists; Display Lists and Modeling; Programming Event Driven Input; Menus; Picking; A simple CAD program; Building Interactive Models; Animating Interactive Programs; Design of Interactive Programs; Logic Operations.	**10 Hours**

MODULE IV

Viewing: Classical and computer viewing; Viewing with a Computer; Positioning of the camera; Simple projections; Projections in OpenGL; Hidden surface removal; Interactive Mesh Displays; Parallel-projection matrices; Perspective-projection matrices; Projections and Shadows. **Lighting and Shading:** Light and Matter; Light Sources; The Phong Lighting model; Computation of vectors; Polygonal Shading; Approximation of a sphere by recursive subdivisions; Light sources in OpenGL; Specification of materials in OpenGL; Shading of the sphere model; Global Illumination.	**10 Hours**

COURSE OUTCOMES

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

CO1	Outline the applications of computer graphics and show the overview of graphics systems and imaging.	CL2
CO2	Explore the features of OpenGL and develop graphical applications.	CL3
CO3	Show the variety of input and interaction devices and develop the event-driven input for graphics programs.	CL3
CO4	Make use of OpenGL in handling viewing and demonstrate the interaction between light and the surfaces in graphical models.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I

M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Edward Angel: Interactive Computer Graphics - A Top Down Approach with OpenGL, 5th edition. Pearson Education, 2011
2. Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version,3rd / 4th Edition, Pearson Education, 2011

3. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: pearson education
4. Xiang, Plastock : Computer Graphics , sham‟s outline series, 2nd edition, TMG.
5. Kelvin Sung, Peter Shirley, steven Baer : Interactive Computer Graphics, concepts and applications, Cengage Learning
6. M M Raikar & Shreedhara K S Computer Graphics using OpenGL, Cengage publication

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc20_cs90/preview

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UHV - 1: SOCIAL CONNECT AND RESPONSIBILITIES

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BHU307TK	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	16L	Exam Hours	01

CREDITS – 1

COURSE PREREQUISITES:

- Have/Develop the critical analysis of the day today happenings.

COURSE OBJECTIVES:

This course will enable students to:

- Enable the student to do a deep drive into societal challenges being addressed by NGO(s), social enterprises & government and build solutions to alleviate these complex social problems through immersion, design & technology.
- Provide a formal platform for students to communicate and connect to their surroundings.
- Enable to create a responsible connection with society.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Connectivity with Nature: Importance of plants**,** Plantation process, **Plant Development:** Sequence of Plant Development, Factors affecting Plant Development, Practice Problems. **Activity:** Self-study on selected plant's origin, its usage in daily life and its appearance in folklore and literature.	**4 Hours**

MODULE II

Heritage walks and Regional Crafts: An overview of Heritage, Awareness on Indian Cultural Heritages, Crafts & Heritage, Protective measures for the survival of handicrafts. **Activity:** Self-study on selected Heritage and its Inheritance.	**4 Hours**

MODULE III

Organic farming and waste management: Introduction of organic farming, study on wet waste Management, Effects of organic farming on crop productivity. **Water Conservation:** Necessity of water conservation, study on water reuse, an overview on rainwater harvesting. **Activity:** Documentary or photo blog presenting the current practices.	**4 Hours**

MODULE IV

Food Practices: Comparative study of traditional food and fast food. Food-lore and indigenous materials of the region used in cooking. Cultural Significance of Meal Times, The Role of Spices and Herbs in Global Cuisines. Food as a Celebration.	**4 Hours**

COURSE OUTCOMES

CO1	Understand the social responsibility of individual-Adaptation and Plantation of Tree	CL2
CO2	Know the heritage and holistic places - Heritage Walk and crafts corner	CL2
CO3	Understand the importance of Organic farming and waste management & Water Conservation	CL2
CO4	Understand diverse food practices, cultural significance, and food traditions across different regions	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

a. Theory SEE will be conducted, with common question papers for the subject (Duration 01 hour)

b. The question paper will have 50 questions. Each question is set for 02 marks.

c. The student has to answer all the questions, selecting one full question from each module.

REFERENCE BOOKS:

1. *Organic Farming for Sustainable Agriculture* by **Saravanan Raj & S. Karthikeyan**, Scientific Publishers.
2. Human values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Exel books, New Delhi 2010
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
4. Human Values, A. N Tripathi, New Age Intl.Publishers,New Delhi, 2004.
5. Small is Beautiful-E F Suchumacher.
6. The Story of Stuff (Book)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/user/ccrtdelhi
2. https://www.eatrightindia.gov.in/
3. https://www.intach.org/

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BASICS OF WEB PROGRAMMING: HTML AND CSS

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BIS308A1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Basic knowledge of programming.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce the foundational concepts of web programming.
- Learn the basics of HTML for structuring web content.
- Provide hands-on experience with CSS for styling web pages.
- Enable the development of responsive web designs.
- Understand the use of frameworks in web design.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PRE-REQUISITE EXPERIMENTS

Exp. No.	Description
1.	Write an HTML program that demonstrates basic document structure including head and body sections.
2.	Create a web page that uses different types of lists and table formatting in HTML.
3.	Use inline and internal CSS to style a simple HTML form layout.

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Create a basic HTML page with headings, paragraphs, and images.
2.	Design a webpage using CSS to style text, layouts, and colors.
3.	Create a registration form using HTML and apply external CSS styles.
4.	Develop a personal portfolio website layout using HTML and CSS.
5.	Use Flexbox and Grid layout techniques in CSS to design page structure.
6.	Implement a responsive web design using media queries.
7.	Design a navigation bar and footer section using semantic HTML5 and CSS.
8.	Use frames to Include Images and Videos.
9.	Write a HTML program for the demonstration of Lists. e. Unordered List f. Ordered List g. Definition List h. Nested List.

COURSE OUTCOMES

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

CO1	Create basic static web pages using HTML elements like headings, paragraphs, lists, tables, and images.	CL2
CO2	Apply CSS for styling text, layout, and responsive design using Flexbox and Grid.	CL3
CO3	Design structured web interfaces with forms, navigation bars, and footers using semantic HTML and CSS.	CL3
CO4	Integrate multimedia elements and frames into web pages effectively.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage

(25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India. (ISBN:978- 9332575271).
2. Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", 4th Edition, O"Reilly Publications, 2015. (ISBN:978-9352130153)
3. Nicholas C Zakas, "Professional JavaScript for Web Developers", 3rd Edition, Wrox/Wiley India, 2012. (ISBN:978- 8126535088)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=17&lesson=18
2. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=26&lesson=27

3. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=43&lesson=44
4. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=52&lesson=53

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DEVOPS FOR BEGINNERS

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BIS308A2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Basic understanding of software development processes.
- Familiarity with version control systems

COURSE OBJECTIVES:

This course will enable students to:

- Introduce the principles and practices of DevOps.
- Explore tools for automation and collaboration in software delivery.
- Understand continuous integration and delivery concepts.
- Highlight the role of monitoring and feedback in DevOps.
- Provide hands-on experience with essential DevOps tools.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Install Git and Create a GitHub Account a. Understand the basics of Version Control Systems (VCS) b. Set up Git on your local machine c. Create and configure a GitHub account
2.	Perform Git Operations Using Git Cheat Sheet a. Initialize repositories, commit changes, manage branches

	b. Push/pull from remote repositories c. Resolve merge conflicts and use Git CLI efficiently
3.	Install and Configure Jenkins with Maven/Ant/Gradle a. Set up Jenkins on a local/remote machine b. Integrate build tools (Maven, Ant, or Gradle) c. Create a basic Jenkins freestyle or pipeline job
4.	Build Jenkins Pipeline for Testing and Deployment a. Create a Jenkins pipeline script (Declarative or Scripted) b. Integrate build, test, and deploy stages c. Deploy the application to a Tomcat server
5.	Implement Jenkins Master-Slave Architecture a. Configure Jenkins to use slave nodes (agents) b. Understand scaling and distributed build execution c. Assign specific jobs to different nodes
6.	Install Docker and Manage Containers a. Understand Docker architecture and container lifecycle b. Use Docker CLI to manage images and containers c. Pull, run, and inspect containers
7.	Create a Dockerfile and Build a Web App Image a. Write Dockerfile with necessary instructions b. Build and tag Docker images c. Run a sample web application using your image
8.	Install and Configure Pull-Based Tools (Puppet/Ansible) a. Understand the architecture of Puppet/Ansible b. Set up a master-agent (Puppet) or control node (Ansible) c. Write simple playbooks (Ansible) or manifests (Puppet)
9.	Understand Puppet Blocks: Manifest, Modules, Classes, Functions a. Create Puppet manifests for basic tasks b. Organize configuration using modules and classes c. Use Puppet functions to enhance provisioning logic
10.	Provision a LAMP/MEAN Stack Using Puppet a. Write Puppet scripts to automate full-stack provisioning b. Deploy Linux + Apache + MySQL + PHP (LAMP) c. OR MongoDB + Express + Angular + Node.js (MEAN)

COURSE OUTCOMES

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

CO1	Identify the core principles and practices of DevOps in the context of modern software development	CL3

CO2	Utilize automation and collaboration tools to enhance software delivery efficiency.	CL3
CO3	Develop continuous integration and continuous delivery (CI/CD) pipelines for streamlined deployment processes.	CL3
CO4	Experiment with essential DevOps tools to understand the role of monitoring and feedback in improving system performance.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY: In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

I. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

II. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot

- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

BOOKS:

1. Gene Kim, Patrick Debois, John Willis, and Jez Humble, The DevOps Handbook, 2016
2. Craig Berg, DevOps For Beginners: A Complete Guide To DevOps Best Practices, 2020
3. Mikael Krief, Learning DevOps: A comprehensive guide to accelerating DevOps culture adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins, Packt Publication, 2nd Edition, 2022
4. Gene Kim, Jez Humble, et.al, The DevOps Handbook: How to Create World-Class Agility, 6. Reliability, & Security in Technology Organizations, IT Revolution Press; 2nd edition 2021
5. Mark Reed, DevOps: The Ultimate Beginners Guide to Learn DevOps Step-By Step, LLC Publication, 2020
6. Emily Freeman, “DevOps for Dummies”, 3rd Edition, Wiley Publication, 2019

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://aws.amazon.com/devops/
2. https://docs.docker.com/

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PROJECT MANAGEMENT WITH GIT

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BIS308A3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Basic understanding of version control systems and collaborative workflows.

COURSE OBJECTIVES:

This course will enable students to:

- Manage projects effectively using Git.
- Learn advanced Git techniques for collaboration.
- Explore project tracking using GitHub Projects.
- Ensure code quality through review workflows.
- Integrate Git with CI/CD pipelines.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses

Any other innovative initiatives with respect to the Course contents

PREREQUISITE EXPERIMENTS

Exp. No.	Description
1.	Installing Git and Setting Up GitHub
2.	Creating a Local Repository and Committing Changes
3.	Cloning a Repository from GitHub
4.	Exploring Git Status and Logs
5.	Basic File Operations and .gitignore

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Creating and Managing Branches
2.	Simulating Team Collaboration via Forks and Pull Requests
3.	Setting Up a GitHub Project Board
4.	Using Issues for Task Tracking
5.	Creating Meaningful Commit Messages
6.	Code Review and Discussion on Pull Requests
7.	Undoing Changes and Reverting Commits
8.	Tagging Releases and Viewing GitHub Releases
9.	Simple Integration with GitHub Actions
10.	Troubleshooting Git Errors

COURSE OUTCOMES

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

CO1	Understand and apply Git for version control in projects.	CL2
CO2	Demonstrate collaborative workflows using GitHub.	CL3
CO3	Apply project tracking techniques using GitHub Projects.	CL3
CO4	Integrate Git with automation tools for quality and delivery.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

1. Online resources: GitHub Documentation, GitTutorials- Atlassian
2. "Pro Git" by Scott Chacon and Ben Straub

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://youtu.be/ekNySzCbZ9A
2. https://youtu.be/ff5cBkPg-bQ

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TAX MANAGEMENT

(Effective from the Academic Year 2025 – 26)

III SEMESTER

Course Code	BIS308A4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	1:0:0:1	SEE Marks	50
Total Hours of Pedagogy	12 L	Exam Hours	01

CREDITS – 1

COURSE PREREQUISITES:

- Basic understanding of the India Taxation System.
- Basic understanding of Direct Tax and GST
- Familiarity with Excel or any spreadsheet software.

COURSE OBJECTIVES:

This course will enable students to:

- Know the legal interpretation and analysis, calculations under different heads of income, and provide advice.
- Gain the expertise to run a business with a proper structure and varied techniques to ensure it is profitable.
- Obtain the awareness of the various terminologies, concepts, theories, practices, and policies related to direct taxation, GST and thus acquainting them with the application of these concepts will enable them as future managers

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses

Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Salary: Meaning, Components of Salary -Allowances (DA, HRA & Others), Perquisites (Rent Free Accommodation, Motor Car), Computation of Gross Total Income and Taxable Total Income from Salary.	**3 Hours**

MODULE II

Deductions U/s 80: Introduction to Direct Tax, Deductions under 80C, 80CCD, 80D, 80TTA from Total	**3 Hours**

Income of an Individual and Tax Liability (Old Regime and New Regime)	
MODULE III	
Goods &Services Tax: Introduction to Goods and Services Tax (GST), GST Model, Goods and Services Tax Network (GSTN), Exemptions from GST	**3 Hours**
MODULE IV	
Computation Transaction Value/Value of Taxable Supply: Meaning and conditions for transaction value, inclusive transaction value, and exclusive discount excluded from transaction Value.	**3 Hours**

COURSE OUTCOMES

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

CO1	Understand the components of a salary structure, including basic pay, allowances, deductions, and benefits, and interpret salary slips to analyze employee compensation and statutory compliance.	CL2
CO2	Identify and evaluate various deductions available under Section 80 of the Income Tax Act, including 80C to 80U, to effectively plan and compute taxable income for individuals and assess tax-saving opportunities.	CL3
CO3	Explain the structure, features, and components of Goods and Services Tax (GST) and apply the concepts of input tax credit, registration, and filing procedures to ensure compliance with the indirect tax system.	CL3
CO4	Compute the transaction value or value of taxable supply under GST by applying relevant provisions, including inclusions and exclusions, to determine the correct tax liability in various business scenarios.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE) Multiple Choice Questions only	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I

M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will be set in the form of Multiple-Choice Questions only
- The total marks of SEE shall be 100

REFERENCE BOOKS:

1. Students Handbook on Taxation T N Manoharan- Snow White Publications Pvt. Ltd
2. Income Tax Law & Practice B. B. Lal & N. Vashisht Pearson
3. Direct Taxes Law and Practice- Vinod Singhania and Kapil Singhania- Taxman Publications.
4. Students' Guide to Income Tax -Vinod Singhania and Kapil Singhania- Taxman Publications
5. Income Tax - H.C. Mehrotra & S.P. Goyal- Sahithya Bhavan Publications.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - E-RESOURCES) :

1. https://onlinecourses.nptel.ac.in/noc22_mg66/preview
2. https://onlinecourses.swayam2.ac.in/cec21_cm02/preview

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ADDITIONAL MATHEMATICS - I

(Effective from the Academic Year 2025 - 26)

III SEMESTER

Course Code	BMA310NK	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	24 L	Exam Hours	3 Hours

CREDITS – 3

COURSE PREREQUISITES:

- Basics of Differentiation and Integration

COURSE OBJECTIVES:

This course will enable students to:

- Enable the students to use the concepts of Vector and Vector Differentiation.
- Study the various methods Solving first order Linear Differential Equations.
- Understand the Basic Concept of Partial Differentiation.

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Vector Algebra and Complex Numbers : **Vector Algebra:** Basic Properties, Dot product and Cross Product of two vectors -Problems. **Complex Numbers:** Polar form, Amplitude and Modulus of a complex number. De-movire's theorem, Argand Diagram.	**6 Hours**

MODULE II

Differential Calculus: Review of elementary differential calculus, nth derivative of elementary functions, Leibnitz Rule, Polar curves - the angle between the radius vector and tangent, Angle between Two curves, Pedal equations.	**6 Hours**

MODULE III	
Differential Equations and Partial differentiation: **Differential Equations**: Solving first order Linear differential equations using Variable separable method, Exact Differential Equations, Linear Differential Equations. **Partial differentiation:** Total derivatives- differentiation of composite functions. Euler's Theorem-Problems. Jacobians-simple problems.	**6 Hours**
MODULE IV	
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrotational vector fields-Illustrative problems.	**6 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Apply the basic concept of vectors, complex numbers to solve engineering problems.	CL3
CO2	Apply the knowledge of calculus to solve problems related to polar curves and their applications.	CL3
CO3	Solve first order differential equation and understand the concepts of partial differentiation.	CL3
CO4	Illustrate the applications of vector calculus and understand the solenoidal and irrotational vectors	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (60%)			Assignment/ Activities (40%)	
I	II	III		
Syllabus Coverage			Syllabus Coverage	Syllabus Coverage
40%	30%	30%	100%	100%
MI			MI	MI
MII	MII		MII	MII
	MIII	MIII	MIII	MIII
		MIV	MIV	MIV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. B.V Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill,
3. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication (2014).

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. http://www.class-central.com/subject/math(MOOCs)
2. http://academicearth.org/
3. http://www.bookstreet.in.
4. VTU e-Shikshana Program

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EMBEDDED SYSTEM DESIGN WITH ARM AND INTERNET OF THINGS

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS401G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamental knowledge of digital electronics and C programming
- Fundamental understanding of the basic operation and function of the IoT system.

COURSE OBJECTIVES:

This course will enable students to:

- Understand the fundamentals of ARM-based systems, basic hardware components, selection methods, and attributes of an embedded system.
- Program the ARM controller using the various instructions.
- Identify the applicability of the embedded system.
- Illustrate diverse methods of deploying smart objects and connect them to the network.
- Identify sensor technologies for sensing real-world entities and understand the role of IoT in various domains of Industry.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

ARM Embedded Systems: RISC, ARM Design Philosophy, Embedded System Hardware and Software. **ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and Vector Table.	**10 Hours**

MODULE II	
ARM Instructions Set: Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instructions, Program Status Register Instruction. **Communication Interface**: Onboard Communication Interface and external Communication Interface.	**10 Hours**
MODULE III	
Introduction to IoT: What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design. **Smart Objects:** The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria.	**10 Hours**
MODULE IV	
IoT Programming with Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. **IoT Programming with RaspberryPi:** Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python. **IoT Applications:** Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture.	**10 Hours**

COURSE OUTCOMES

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

CO1	Apply ARM processor fundamentals and embedded system concepts to configure basic embedded hardware and software components.	CL3
CO2	Implement embedded system functionality using ARM instruction sets and onboard/external communication interfaces.	CL3
CO3	Analyze the structure and challenges of IoT systems by examining network architecture, smart objects, sensors, and connectivity requirements in IoT environments.	CL3
CO4	Develop IoT-based applications by programming Arduino and Raspberry Pi platforms, integrating sensors and actuators for smart city and connected system solutions.	CL4

LABORATORY CONTENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Implement an ALP to find the factorial of a number.	CL4
2.	Implement an ALP to find the square of a number (1 to 10) using a look-up table.	CL4
3.	Implement an ALP to arrange a series of 32-bit numbers in ascending/descending order.	CL4

4.	Implement an ALP to find the largest/smallest number in an array of 32 numbers.	CL4
5.	Implement an ALP to count the number of ones and zeros in two consecutive memory locations.	CL4
6.	Interface and Control a DC Motor.	CL4
7.	Interface a Stepper motor to rotate it in a clockwise and anti-clockwise direction.	CL4
8.	Interface a DAC and generate Triangular and Square waveforms.	CL4
9.	Display "Hello World" message using UART with IoT.	CL4
10.	Interface a smoke sensor with Arduino/Raspberry Pi and write a program to turn on the alarm when smoke is detected.	CL4
11.	Interface the DHT11 sensor with Arduino/Raspberry Pi and write a program to read temperature and humidity values.	CL4
12.	Interface Bluetooth with Arduino/Raspberry Pi and write a program to turn the LED ON/OFF when '1'/'0' is received from smart phone using Bluetooth.	CL4

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (30%)			**Assignment (20%)**	**Practical (50%)**	
I	**II**	**III**			
Syllabus Coverage			**Syllabus Coverage**		**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**	**100%**
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode:

- The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)
- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**

- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling to 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e. 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)

- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers,2008.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw-Hill Education, Private Limited, 2 nd Edition.
3. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.
4. Raghunandan. G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
5. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry; "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
6. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2023

Reference Web Links and Video Lectures (E-Resources):

1. https://onlinecourses.nptel.ac.in/noc25_cs29/unit?unit=17&lesson=18
2. https://docs.arduino.cc/
3. https://www.arduino.cc/education/certification
4. https://www.udemy.com/topic/arduino/

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OPERATING SYSTEMS

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS402G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUIS

ITES:

- Fundamental knowledge of Data Structures, Algorithms, and Computer Organization

COURSE OBJECTIVES:

The course will enable the student to

- Obtain awareness on concepts of operating systems and structures.
- Understand and implement the concept of Process and threads
- Demonstrate the common synchronization problems arising in the Operating systems and provide solutions to them
- Demonstrate the issue of deadlock and handle it effectively.
- Understand the concept of Memory and demonstrate its management using various strategies.
- Know the various storage mechanisms available and discuss the management of storage space

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Operating Systems and Structures: Introduction, user view, system view, Single processor systems, multiprocessor systems, clustered systems, multiprogramming and multitasking, dual mode and multimode	**10 Hours**

operations, Distributed systems, Computing environments, Operating System services, System Calls, Linkers and Loaders, Operating system design and implementation, Operating System Structures **Process Management:** Process concept, process state, process control block, context switch; operations on processes, inter-process communication.	

MODULE II	
Multi-Threaded Programming: Overview of threads, multithreading models. **CPU Scheduling:** Schedulers, Pre-emptive and non-preemptive scheduling. **Scheduling Algorithms:** FCFS, SJF, SRTF, RR, Priority, HRRN**. Process Synchronization**: Background, critical section problem, Peterson's solution, and semaphores.	**10 Hours**

MODULE III	
Deadlocks: Necessary conditions for deadlocks, methods for handling deadlocks. Deadlock avoidance - resource allocation graph algorithm, banker's algorithm, deadlock detection, recovery from deadlock. **Memory Management:** Background, contiguous memory allocation, paging, swapping. **Virtual Memory Management:** Background; demand paging: copy-on-write; page replacement algorithms - FIFO, Optimal, and LRU.	**10 Hours**

MODULE IV	
File System Interface and Operations: File system structure, Directory implementation, Allocation methods. **Storage Management and Security:** Mass storage structures; Disk scheduling algorithms, Swap space management. **Case Studies**: Popular Operating Systems.	**10 Hours**

COURSE OUTCOMES

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

CO1	Illustrate the Operating System, its components, and the idea behind the system calls and Inter-Process communications.	CL2
CO2	Use the concepts of multithreading and demonstrate various algorithms by considering different scheduling criteria.	CL3
CO3	Explain the concepts of process synchronization, deadlock, and apply the various page replacement algorithms for evaluating system performance.	CL3
CO4	Analyze the structure of mass storage devices, various disk scheduling techniques, and concepts of Operating system protection.	CL4

LABORATORY COMPONENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1	Write a Shell Script that accepts a file name, starting and ending line numbers as arguments, and displays all lines between the given line numbers.	CL3
2	Write a shell script that displays a list of all files in the current directory to which the user has read, write, and execute permissions.	CL3
3	Write a shell script to find the factorial of a given number.	CL3
4	Write C programs to implement basic UNIX system calls – read(), write(), open(), close(), lseek(), create().	CL3
5	Write C programs to implement UNIX Directory API's – opendir, closedir, readdir, mkdir.	CL3
6	Demonstrate the Process creation and Termination using System calls –fork (), vfork (), getpid (), waitpid (), exec, exit (), return 0.	CL3
7	Simulate the following CPU scheduling algorithms: 1. FCFS 2. SJF 3. Round Robin. Calculate Average Waiting Time, Average Turn-Around Time, Average Response Time for each algorithm.	CL3
8	Demonstrate the following Classical problems of synchronization using semaphores. a. Producer-Consumer b. Dining Philosopher	CL3
9	Demonstrate the following page replacement algorithms: a. LRU b. OPTIMAL	CL3
10	Discuss the seek time for the following Disk scheduling algorithms – 1. FCFS 2. SCAN	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III

		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode:

- The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)
- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)

- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Principles", 10th edition, Wiley-India, 2021
2. M. Morris Mano, "Computer System Architecture", PHI, 3rd Edition
3. Ann McHoes, Ida M Fylnn, "Understanding Operating Systems", Cengage Learning, 6th Edition
4. D.M Dhamdhere, "Operating Systems: A Concept Based Approach", 3rd Edition, McGraw-Hill, 2013.
5. P.C.P. Bhatt, "An Introduction to Operating Systems: Concepts and Practice", 4th Edition, PHI(EEE), 2014.
6. William Stallings, "Operating Systems: Internals and Design Principles", 6th Edition, Pearson.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.geeksforgeeks.org/operating-systems/
2. https://www.youtube.com/watch?v=RozoeWzT7IM&list=PLdo5W4Nhv31a5ucW_S1K3-x6ztBRD-PNa
3. https://en.wikipedia.org/wiki/Operating_system
4. https://www.youtube.com/watch?v=By6lWjiPpVI&list=PLG9aCp4uE-s17rFjWM8KchGlffXgOzzVP
5. https://www.youtube.com/watch?v=bkSWJJZNgf8&list=PLxCzCOWd7aiGz9donHRrE9I3Mwn6XdP8

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SOFTWARE ENGINEERING AND PROJECT MANAGEMENT

(Effective from the Academic Year 2025 – 26)

IV SEMESTER

Course Code	BIS403T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamentals of data structures and object oriented concepts.

COURSE OBJECTIVES:

This course will enable students to:

- Outline software engineering principles and activities involved in building large software programs.
- Identify ethical and professional issues and explain why they are of concern to Software Engineers.
- Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.
- Explain the role of DevOps in Agile Implementation.
- Discuss various types of software testing practices and software evolution processes.
- Recognize the importance Project Management with its methods and methodologies.
- Identify software quality parameters and quantify software using measurements and metrics.
- List software quality standards and outline the practices involved.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction: Professional software development, Software engineering ethics. **Software processes:** Software process models, Process activities, Coping with change, The rational unified	**10 Hours**

process. **Agile Software Development**: Agile methods, Plan-driven and agile development, Extreme programming, Agile project management, Scaling agile methods.	
MODULE II	
Requirements Engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management. **Software Testing:** Development testing, Test-driven development, Release testing, User testing	**10 Hours**
MODULE III	
Introduction to Project Management: Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.	**10 Hours**
MODULE IV	
Activity Planning: Objectives of Activity Planning, When to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks, Activity on Nodes Network. **Quality Management:** Software quality, Software standards, Reviews and inspections, Software measurement and metrics	**10 Hours**

COURSE OUTCOMES

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

CO1	Outline the activities involved in software engineering and show the role of various process models.	CL2
CO2	Explain the process of requirement engineering and demonstrate the various software testing methods.	CL2
CO3	Illustrate the Concepts of project planning and contract management in software development.	CL2
CO4	Illustrate the importance of activity planning and its models and develop network models for project specification.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20

2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.
2. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018
3. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
4. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.
5. Deepak Gaikwad, Viral Thakkar, DevOps Tools from Practitioner's Viewpoint, Wiley.
6. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc20_cs68/preview
2. https://onlinecourses.nptel.ac.in/noc24_mg01/preview
3. https://www.youtube.com/watch?v=WxkP5KR_Emk&list=PLrjkTql3jnm9b5nrggx7Pt1G4UAHeFlJ
4. http://elearning.vtu.ac.in/econtent/CSE.php
5. http://elearning.vtu.ac.in/econtent/courses/video/CSE/15CS42.html
6. https://nptel.ac.in/courses/128/106/128106012/ (DevOps)

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DESIGN AND ANALYSIS OF ALGORITHMS

(Effective from the Academic Year 2025 – 26)

IV SEMESTER

Course Code	BIS404T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of Mathematics, Data Structures.

COURSE OBJECTIVES:

This course will enable students to:

- Describe the techniques for analyzing algorithms and how to evaluate their performance. Indicate the effectiveness of the method using asymptotic notations.
- Utilize algorithm design techniques, including the brute force approach, greedy approach, divide-and-conquer strategy, decrease-and-conquer strategy, transform-and-conquer strategy, dynamic programming, backtracking, and branch-and-bound to solve issues.
- Decide on the best data structure and algorithm design technique for the given application.
- Recognize the fundamental ideas behind NP-complete and NP-hard class issues.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Algorithms- Properties, Specification, Fundamentals of Algorithmic Problem solving, Analysis Framework.	**10 Hours**

Performance Analysis: Estimating Space complexity and Time complexity of algorithms. Asymptotic Notations with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples. **Brute force design techniques:** Selection sort, sequential search and String-matching algorithm with complexity Analysis. **Divide and Conquer:** General method, Recurrence equation for divides and conquers, solving it using Master's theorem. Divide and Conquer algorithms and complexity Analysis of Finding the maximum & minimum, Binary search, Merge sort and Quick sort.	
MODULE II	
Decrease and Conquer Approach: Introduction, Insertion sort, Topological Sorting, and efficiency analysis. **Greedy Method:** General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems. **Minimum cost spanning trees:** Prim's Algorithm, Kruskal's Algorithm with performance analysis. **Single-source shortest paths:** Dijkstra's Algorithm. **Optimal Tree problem:** Huffman Trees and Codes.	**10 Hours**
MODULE III	
Transform and Conquer Approach: Introduction, Heaps and Heap Sort. **Dynamic Programming:** General method with Examples and multistage Graphs. **Transitive Closure:** Warshall's Algorithm. **All Pairs Shortest Paths:** Floyd's Algorithm, Knapsack problem, Optimal Binary Search Trees, Travelling Salesperson problem.	**10 Hours**
MODULE IV	
Space-Time Tradeoffs: Introduction, Sorting by Counting, Input Enhancement in String Matching-Harspool's algorithm. **Backtracking:** General method, solution using backtracking to the N-Queens problem, Sum of subsets Problem and Hamiltonian cycles Problems. **Branch and Bound:** Assignment Problem, Travelling Sales Person problem, Knapsack problem **NP-Complete and NP-Hard problems:** Basic concepts, non-deterministic algorithms, P, NP, NP- Complete and NP-Hard classes.	**10 Hours**

COURSE OUTCOMES

Sl. No	Course Outcomes	Blooms taxonomy
CO1	Apply algorithm analysis techniques and brute force, divide and conquer strategies to solve problems using sorting, searching, and string matching.	CL3

CO2	Apply decrease and conquer, greedy methods, and graph algorithms like Prim's, Kruskal's, and Dijkstra's to solve optimization and pathfinding problems.	CL3
CO3	Apply dynamic programming, Floyd's algorithm, Warshall's algorithm, and tree-based techniques to solve shortest path and optimization problems.	CL3
CO4	Apply backtracking, branch and bound, and space-time tradeoff techniques to solve problems such as N-Queens, knapsack, TSP, and string matching.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15

11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, 2012. Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press. Reference Books
3. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
4. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLyqSpQzTE6M9DKhN7z2fOpKTJWu-639_P
2. https://www.youtube.com/watch?v=5Y8Lfsreeck&list=PL7DC83C6B3312DF1E
3. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_VZKxRKrxgFyOutPJpoLFBaQMOpK-

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DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS405L	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Knowledge of Mathematics, Data Structures, and Programming

COURSE OBJECTIVES:

This course will enable students to:

- Design and implement various algorithms in C/C++/Java programming using suitable development tools to address different computational challenges. Make use of different algorithmic design techniques to solve problems.
- Apply diverse algorithmic design strategies for effective problem-solving.
- Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.

TEACHING - LEARNING STRATEGY

The following are some sample strategies that can be incorporated for the Course Delivery:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PRE-REQUISITE EXPERIMENTS

Exp. No.	Description
1.	Write a program to create a class called Student with attributes like name, roll number, and marks in three subjects. Write methods to calculate the student's total marks, average, and grade based on the average. Demonstrate the use of constructors, getters, setters, and object creation in Java.
2.	Write a program to implement Binary Search on a sorted array and find a given element.
3.	Write a program to sort an array of integers using Insertion Sort.

4.	Write a program to search for an element in an array using Sequential Search.
5.	Write a program to solve the Tower of Hanoi problem for n disks using recursion.

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Design and implement a Program to sort a given set of n integer elements using the Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2.	Design and implement a Program to sort a given set of n integer elements using the Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3.	Design and implement a Program to obtain the Topological ordering of vertices in a given digraph.
4.	Design and implement a Program to solve discrete Knapsack and continuous Knapsack problems using the greedy approximation method.
5.	Design and implement a Program to find the Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
6.	Design and implement a Program to find the shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
7.	a. Design and implement a Program to solve the All-Pairs Shortest Paths problem using Floyd's algorithm. b. Design and implement a Program to find the transitive closure using Warshal's algorithm.
8.	Design and implement a Program to solve 0/1 Knapsack problem using the Dynamic Programming method.
9.	Design and develop a program to solve the Travelling Salesperson Problem (TSP) using Branch and Bound. Use an adjacency matrix to represent cities and distances. Find the shortest route that visits each city once and returns to the starting city, displaying the route and the minimum cost..
10.	Design and implement a Program to find a subset of a given set S = {sl , s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.

COURSE OUTCOMES

Sl. No	Course Outcomes	Blooms Taxonomy Level
CO1	Apply sorting and graph traversal algorithms to implement selection sort, merge sort, and topological ordering, and analyze their time complexities.	CL3
CO2	Apply greedy strategies to solve problems such as knapsack approximation and minimum spanning trees using Kruskal’s algorithm.	CL3
CO3	Apply graph algorithms to find shortest paths and transitive closures using Dijkstra’s, Floyd’s, and Warshall’s algorithms.	CL3

CO4	Apply dynamic programming and branch-and-bound techniques to solve optimization problems like 0/1 knapsack, subset sum, and travelling salesperson.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

I. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

II. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50

- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

BOOKS:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed., Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw-Hill, 2014.
3. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, Pearson.
4. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, Universities Press.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://nptel.ac.in/courses/106106182.

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ADVANCED GRAPH THEORY

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BCS406W1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basic knowledge of Graph Theory.

COURSE OBJECTIVES:

This course will enable students to:

- Learn fundamental concepts and to explore modern applications of Graph Theory for problem-solving and network analysis
- Apply the concepts of a planar graph, matching and coloring in computer science engineering.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Graphs and Subgraphs: Definitions and Examples of Graphs, Subgraphs, walks, paths and circuits. Operations on graphs, Connected and Disconnected Graphs, Complements, Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, Hamiltonian paths and circuits.	**08 Hours**

MODULE II

Trees and Connectivity Graphs **Trees**: Definitions, properties, pendant vertex, Distance and centres in a tree - Rooted and binary trees, weighted trees, spanning trees, Sorting, Prefix codes, Optimal tree.	**08 Hours**

Connectivity Graphs: Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits. Network Flows- Max- flow Min-cut Theorem (Statement only and problems).	

MODULE III

Graph Representations and Planar Graphs **Graph Representations**: Matrix representation of graphs-Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix. **Planar Graphs**: Planar graphs, Kuratowski's theorem (proof not required), Different representations of planar graphs, Detection of planar graphs, Homeomorphic graphs, Euler's theorem, Dual of a planar graph.	**12 Hours**

MODULE IV

Colouring, Matching, Dominating sets and Graph Theoretic Algorithms **Coloring and Matching:** Graph Coloring, Chromatic Polynomial, Chromatic Partitioning, Matching, Covering - Related Theorems. **Dominating sets:** Dominating set. Minimal Dominating set. Domination number. Independent dominating set. Finding minimal dominating sets. **Graph Theoretic Algorithms:** Computer representation of a graph. Algorithm on spanning trees: Kruskal's and Prim's Algorithm (Problems), Graphs in switching theory-Contact networks, analysis of contact networks.	**12 Hours**

COURSE OUTCOMES

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

CO1	Apply the fundamental concepts and properties of graphs and subgraphs.	CL3
CO2	Solve complex problems using properties of trees and connectivity graphs in Computer science.	CL3
CO3	Apply the concepts of planar graph and graph representations to solve the given problem	CL3
CO4	Develop graph algorithms to solve problems in network analysis, optimization, and decision-making.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		

Syllabus coverage			Syllabus Coverage	Syllabus Coverage
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Printice Hall of India Private Limited, 2009.
2. Grimaldi R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Addison Wesley, 5th edition, 2006.
3. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication,2008.
4. West, D. B., ―Introduction to Graph Theory‖, Pearson Education, 2011.
5. John Clark, Derek Allan Holton, ―A First Look at Graph Theory‖, World Scientific Publishing Company, 1991.
6. Rosen K.H., “Discrete Mathematics and Its Applications”, Mc Graw Hill, 2007.Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://users.utu.fi/harju/graphtheory/graphtheory.pdf.
2. https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf
3. https://www.academia.edu/35284015/Graph_Theory_With_Applications_To_Engineering_And_Computer_Science_by_Narsingh_Deo
4. https://onlinecourses.nptel.ac.in/noc22_ma10/preview#:~:text=Graph%20theory%20is%20the%20core,primary%20methods%20in%20Graph%20Theory.

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LINEAR ALGEBRA

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BCS406W2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Applied Mathematics-I, Applied Mathematics-II

COURSE OBJECTIVES:

This course will enable students to:

- Equip the students with standard concepts and tools in Linear algebra which will find them useful in their disciplines.
- Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Vector Spaces and Linear Transformations: **Vector Spaces:** Introduction, Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates. **Linear Transformations:** Introduction, Linear Mappings, Geometric linear transformation of i2, Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof)	**08 Hours**

MODULE II

Eigenvalues and Eigenvectors: Introduction, Polynomials of Matrices, Applications of Cayley-Hamilton	**08 Hours**

Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form**.**	

MODULE III

Inner Product Spaces: Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error.	**12 Hours**

MODULE IV

Optimization Techniques in Linear Algebra: Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and their classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction – Principal component analysis.	**12 Hours**

COURSE OUTCOMES

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

CO1	Apply the concepts of vector spaces, subspaces, linear dependence/independence, and basis, and apply them to solve problems related to linear transformations and matrix spaces.	CL3
CO2	Analyze eigenvalues, eigenvectors, and the structure of matrices using tools such as the Cayley-Hamilton theorem, characteristic and minimal polynomials, and Jordan canonical form.	CL3
CO3	Apply inner product space theory to orthogonalization, projections, and least squares problems using methods like Gram-Schmidt process and QR factorization.	CL3
CO4	Evaluate and implement optimization techniques in linear algebra including diagonalization, PCA, SVD, and the method of steepest descent for applications in engineering and data science.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. David C. Lay, Steven R. Lay, Judi J Mc. Donald: "Linear Algebra and its applications", Pearson Education, 6th Edition, 2021.
2. Gilbert Strang: "Linear Algebra and its applications", Brooks Cole, 4th edition,2005.
3. Richard Bronson & Gabriel B. Costa: "Linear Algebra: An Introduction", 2nd edition. Academic Press, 2014.
4. Seymour Lipschutz, Marc Lipson: "Theory and problems of linear algebra", Schaum's outline series - 6th edition, 2017, McGraw-Hill Education.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
2. https://www.math.ucdavis.edu/~linear/linear.pdf
3. https://www.coursera.org/learn/linear-algebra-machine-learning
4. https://nptel.ac.in/syllabus/111106051/
5. http://nptel.ac.in/courses.php?disciplineID=111
6. http://www.class-central.com/subject/math(MOOCs)
7. http://academicearth.org/
8. VTU e-Shikshana Program
9. VTU EDUSAT Program.

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METRIC SPACES

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BCS406W3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basic knowledge of Set theory and Group theory

COURSE OBJECTIVES:

This course will enable students to:

- Introduce metric theory, emphasizing its application in analyzing and optimizing data structures, algorithms, and network performance.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Metric Spaces: Definition of metric space. Examples of metric spaces. **Metrics and Distance Functions:** Properties of metrics. Common distance functions. Open and Closed Sets, Definitions and properties.	**08 Hours**

MODULE II

Topology of a Metric Space: Topological concepts, Convergence and Limit Points, Convergence of sequences and series. Limit points, limit set. **Continuity in Metric Spaces**: Continuous functions in metric spaces. Properties of continuous functions. **Applications:** Routing algorithms using metrics. Latency and distance metrics in network design.	**08 Hours**

MODULE III	
Compactness and Completeness: Connectedness, separated sets, Connected and disconnected sets, Components of metric spaces, Connectedness of product of connected metric spaces. Bounded sets and Compactness, Other Characterizations of Compactness, Continuous Functions on Compact Spaces, Locally Compact Spaces.	**12 Hours**

MODULE IV	
Cauchy Sequences and Completeness: Cauchy sequences and completeness. Applications in analysis. **Compactness and Bolzano-Weierstrass Theorem**: Bolzano-Weierstrass theorem. Compactness and its applications. **Applications in Computer Networks:** Metric Spaces in Geometry and Graphics: Geometric interpretations of metric spaces. Graphics algorithms and spatial metrics.	**12 Hours**

COURSE OUTCOMES

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

CO1	Use Metric space concepts in computer science engineering, enhancing problem-solving skills and algorithm optimization.	CL3
CO2	Apply topological concepts and continuous functions in metric spaces to enhance problem-solving skills in computer science.	CL3
CO3	Demonstrate compactness and apply concepts of Metric space to optimize network design and data compression.	CL3
CO4	Apply Cauchy sequences, completeness, and compactness to solve problems in mathematical analysis and optimization.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III

		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Metric Spaces by Satish Shirali and Harikrishan L Vasudeva Springer, (2006)
2. Metric Spaces by P.K. Jain and Khalil Ahmad, Alpha Science International, (2004)
3. Elements of Metric spaces by M.N. Mukherjee, Academic Publishers (2005)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://ocw.mit.edu/courses/18-s190-introduction-to-metric-spaces-january-iap-2023/?utm_source=chatgpt.com
2. https://anton-petrunin.github.io/metric-geometry/tex/lectures.pdf?utm_source=chatgpt.com
3. https://en.wikipedia.org/wiki/Metric_space?utm_source=chatgpt.com

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PROBABILITY AND STATISTICS

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS406W4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basics of Permutation, combination and Set theory.

COURSE OBJECTIVES:

This course will enable students to:

- Review the fundamental principles of probability and understand the behavior of discrete and continuous random variables through their distributions and moments.
- Introduce the concept of joint, marginal, and conditional distributions of two-dimensional random variables and explain the use of correlation and regression in statistical analysis.
- Equip students with knowledge of statistical inference, including estimation and hypothesis testing for population parameters using various parametric tests (z, t, χ^2, F).
- Familiarize students with the principles and techniques of experimental design and the analysis of variance (ANOVA)

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Probability And Random Variables: Probability – Review of axioms of probability – Conditional probability – Baye's theorem, Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Exponential and Normal distributions.	**08 Hours**

MODULE II

Two – Dimensional Random Variables: Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression. Central limit theorem (for independent and identically distributed random variables).	**08 Hours**

MODULE III

Testing of Hypothesis: Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion – Contingency table (test for independent) – Goodness of fit.	**12 Hours**

MODULE IV

Design of Experiments & ANOVA: Principles of experimentation in design, Analysis of completely randomized design, and randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA. Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance	**12 Hours**

COURSE OUTCOMES

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

CO1	Apply fundamental concepts of probability and random variables to compute expectations and analyze standard distributions such as Binomial, Poisson, Exponential, and Normal.	CL3
CO2	Analyze joint, marginal, and conditional distributions of two-dimensional random variables and evaluate measures like covariance, correlation, and regression.	CL3
CO3	Formulate and test hypotheses using appropriate statistical methods, including z, t, chi-square, and F tests, and interpret the results for real-life datasets.	CL3
CO4	Design experiments using ANOVA techniques and analyze experimental data using RBD, Latin Square models.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II

	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. B. S. Grewal "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. Peter Bruce, Andrew Bruce & Peter Gedeck "Practical Statistics for Data Scientists." O'Reilly Media, Inc., 2nd edition 2020.

4. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 9th Edition, 2006.
5. G Haribaskaran “Probability, Queuing Theory & Reliability Engineering”, Laxmi Publication, Latest Edition, 2006
6. B.V. Ramana: “Higher engineering mathematics” Tata McGraw-Hill Publishers, Fifth reprint 2008.
7. S C Gupta and V K Kapoor, “Fundamentals of Mathematical Statistics”, S Chand and Company, Latest edition.
8. Robert V. Hogg, Joseph W. McKean & Allen T. Craig. “Introduction to Mathematical Statistics”, Pearson Education 7th edition, 2013

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. Web links and Video Lectures (e-Resources): http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. http://www.bookstreet.in.
5. VTU EDUSAT PROGRAMME
6. VTU e-Shikshana Program

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UHV-2: UNDERSTANDING HARMONY AND ETHICAL CONDUCT

(Effective from the Academic Year 2025 – 26)

IV SEMESTER

Course Code	BHU407TK	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	16L	Exam Hours	01

CREDITS – 1

COURSE PREREQUISITES:

- Have/Develop the critical analysis of the day today happenings.

COURSE OBJECTIVES:

This course will enable students to:

- Make the students to understand, the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
- Highlight possible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education). Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations.	**3 Hours**

MODULE II

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health.	**4 Hours**

MODULE III

Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order. **Harmony in the Nature/Existence**: Understanding Harmony in the Nature, Inter-connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.	**5 Hours**

MODULE IV

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.	**4 Hours**

COURSE OUTCOMES

CO1	Understand value education to develop basic human aspirations through a holistic approach	CL2
CO2	Relate to the needs of self and body to establish co-existence leading to harmony in the human being.	CL2
CO3	Recognize the importance of trust and respect to promote harmony in the family and society. And realize the existence as coexistence to establish harmony through mutual fulfillment among four orders of nature.	CL2
CO4	Recognize the needs for a holistic understanding of human values to develop ethical and professional conduct.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)		Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (60%)	**Assignment/**	

I	II	III	Activities (40%)	
Syllabus coverage			Syllabus Coverage	Syllabus Coverage
35%	35%	30%	100%	100%
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

a. Theory SEE will be conducted, with common question papers for the subject (Duration 01 hour)

b. The question paper will have 50 questions. Each question is set for 02 marks.

c. The student has to answer all the questions, selecting one full question from each module.

REFERENCE BOOKS:

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2. The Teacher's Manual Teachers" Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana
3. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
4. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
5. 3The Story of Stuff (Book).
6. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
7. Small is Beautiful - E. F Schumacher.

8. Gandhi - Romain Rolland (English)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.aicteindia.org/sites/default/files/Vol.%20II%20%20AICTE%20UG%20%20Curriculum.
2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
3. https://fdp-si.aicte-india.org/8dayUHV_download.php
4. https://www.youtube.com/watch?v=8ovkLRYXIjE

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JAVASCRIPT ESSENTIALS

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS408A1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES

- Basic knowledge of HTML and CSS.

COURSE OBJECTIVES:

This course will enable students to:

- Understand the basic syntax and features of JavaScript.
- Learn DOM manipulation for interactive web applications.
- Explore modern ES6+ features.
- Grasp asynchronous programming concepts.
- Build simple web applications using JavaScript.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PRE-REQUISITE EXPERIMENTS

Exp. No.	Description
1.	Write an HTML document demonstrating the use of basic form elements (textboxes, buttons, dropdowns) and display input values using JavaScript alert() or console.log().
2.	Create a web page using internal and external CSS to style elements such as paragraphs, lists, tables, and forms.
3.	Write a basic JavaScript program to declare variables, use control statements (if, switch, for, while), and display output through the DOM.

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Write a JavaScript program to perform arithmetic operations (add, subtract, multiply, divide).
2.	Design a dynamic web page with validation using JavaScript.
3.	Write an XML for student information and access second students data using DOM.
4.	Design an HTML having a text box and four buttons viz Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate JavaScript function should be called to display a. Factorial of that number b. Fibonacci series up to that number
5.	Write JavaScript programs on Event Handling a. Open a Window from the current window b. Change color of background at each click of button or refresh of a page c. Display calendar for the month and year selected from combo box d. On Mouse over event
6.	Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10
7.	Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters.
8.	Fetch and Display Data from a Public API Using JavaScript Fetch API
9.	Write a JavaScript for loop that will iterate from 0 to 15. For each iteration, it will check if the current number is odd or even, and display a message to the screen

COURSE OUTCOMES

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

CO1	Apply fundamental JavaScript concepts to develop arithmetic, loop-based, and conditional logic.	CL2
CO2	Implement form validation, dynamic content rendering, and DOM manipulation using JavaScript.	CL3
CO3	Utilize JavaScript for event handling, input processing, and user interaction in web applications.	CL3
CO4	Demonstrate the use of APIs, data fetching, and XML/JSON data manipulation in client-side scripting.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15

	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India. (ISBN:978- 9332575271).
2. Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", 4th Edition, O"Reilly Publications, 2015. (ISBN:978-9352130153)
3. Nicholas C Zakas, "Professional JavaScript for Web Developers", 3rd Edition, Wrox/Wiley India, 2012. (ISBN:978- 8126535088)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=17&lesson=18
2. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=26&lesson=27
3. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=43&lesson=44
4. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=52&lesson=53
5. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=75&lesson=76

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CI/CD PIPELINE

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS408A2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Familiarity with version control systems
- Familiarity with basic scripting knowledge

COURSE OBJECTIVES:

This course will enable students to:

- Introduce the concepts of continuous integration and delivery.
- Explore tools for automating the CI/CD pipeline.
- Learn best practices for deployment automation.
- Integrate security into the pipeline.
- Manage pipeline monitoring and optimization.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Install Jenkins, configure basic settings, and create your first freestyle job a. Install Jenkins on your system b. Access Jenkins dashboard and configure plugins c. Create a freestyle project to build a simple “Hello World” app d. Run the job and check build output

2.	Create a pipeline job using a Jenkinsfile stored in a Git repository a. Create a Jenkinsfile with stages: Checkout, Build, Test, Deploy (echo steps) b. Link Jenkins pipeline job to Git repo with Jenkinsfile c. Trigger pipeline and observe stages in console
3.	Add automated unit testing into the pipeline a. Add a unit testing framework (JUnit, Mocha, etc.) to your app b. Modify Jenkins file to run unit tests after build c. Configure Jenkins to publish test reports d. Trigger build and verify tests run and results reported
4.	Automate static code analysis (SonarQube or similar) in the CI process a. Setup SonarQube server (or cloud) b. Integrate SonarQube scanning into Jenkins pipeline stage c. Run pipeline and analyze code quality report d. Fail build on quality gate failure
5.	Create a Docker image for your web application and run it locally a. Write Dockerfile for your application b. Build and run Docker container c. Test application access via container port
6.	Push Docker Image to Docker Hub or Registry a. Create Docker Hub account and login from CLI b. Tag and push Docker image to Docker Hub c. Verify image availability on Docker Hub
7.	Deploy your Docker image on a Kubernetes cluster a. Create Kubernetes Deployment and Service YAML files b. Use kubectl to deploy and expose app c. Access application via NodePort or LoadBalancer
8.	Scale application replicas and perform rollback on failure a. Scale deployment to multiple replicas. b. Simulate faulty deployment and rollback to previous version. c. Monitor pods and status with kubectl
9.	Integrate Security Scanning into Jenkins Pipeline a. Install and configure security scanning tool b. Add scanning stage in Jenkins pipeline c. Fail build if vulnerabilities found d. Review scan reports
10.	Secure sensitive data using Jenkins Credentials and/or HashiCorp Vault a. Store secrets in Jenkins Credentials Manager. b. Access secrets securely in pipeline scripts.

	c. Optionally, integrate Vault for secret management. d. Verify secrets are not exposed in logs.

COURSE OUTCOMES

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

CO1	Identify the concepts of continuous integration and continuous delivery	CL3
CO2	Utilize tools for automating the CI/CD pipeline	CL3
CO3	Develop deployment automation practices with integrated security	CL3
CO4	Solve issues related to CI/CD pipeline monitoring and optimization	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).
Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).
Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.

- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

BOOKS:

1. Jez Humble and David Farley, Continuous Delivery,2010
2. Mark S. Merkow, “Practical Security for Agile and DevOps”, CRC Press Taylor & Francis, 2022

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://docs.github.com/en/actions
2. https://kubernetes.io/docs/home/

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JIRA FUNDAMENTALS

(Effective from the Academic Year 2025 - 26)

IV SEMESTER

Course Code	BIS408A3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Basic understanding of project management and task tracking tools.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce JIRA for managing projects and tasks.
- Explore workflows and issue tracking in JIRA.
- Learn to create and manage dashboards and reports.
- Integrate JIRA with other tools for collaboration.
- Ensure effective communication within teams using JIRA.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PREREQUISITE EXPERIMENTS

Exp. No.	Description
1.	Introduction to Project Management Tools
2.	Understanding Agile and Scrum Basics
3.	Creating a Sample Project Plan
4.	Introduction to Issue Tracking Terminology
5.	Simulating a Sprint Board on a Whiteboard or Chart Paper

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Creating a JIRA Account and Exploring the Interface
2.	Creating a New Project in JIRA (Scrum & Kanban)
3.	Adding Issues: Tasks, Bugs, and Stories
4.	Creating and Managing Epics and Subtasks
5.	Customizing Workflows
6.	Using Labels, Priorities, and Due Dates
7.	Creating and Managing Sprint Backlogs
8.	Creating Dashboards and Adding Gadgets
9.	Generating Basic Reports (Burndown, Velocity, Issue Statistics)
10.	Integrating JIRA with GitHub and Logging Work

COURSE OUTCOMES

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

CO1	Apply fundamental concepts of project management and issue tracking using JIRA.	CL3
CO2	Create and manage projects, issues, workflows, and boards in JIRA for task organization.	CL3
CO3	Design custom dashboards and generate basic reports to track project progress.	CL3
CO4	Integrate JIRA with tools like GitHub or Confluence to support team collaboration.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

1. Online resources: JIRATutorials- Atlassian, JIRABasics- YouTube
2. "JIRA Software Essentials" by Patrick Li.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://youtu.be/fiWaMGCMyk8
2. https://youtu.be/CjL0Vkoyewg

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FINANCIAL MANAGEMENT

(Effective from the Academic Year 2025 – 26)

IV SEMESTER

Course Code	BBA408A4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12 L	Exam Hours	01

CREDITS – 1

COURSE PREREQUISITES:

- Understanding the time value of money (e.g., present and future value)
- Ability to interpret data, analyze problems logically, and apply quantitative techniques to decision-making.

COURSE OBJECTIVES:

This course will enable students to:

- Understand the basics of financial management and its importance in business.
- Learn to analyze financial statements and evaluate a company's performance.
- Develop skills to calculate and apply the time value of money.
- Gain knowledge of budgeting and managing financial resources.
- Understand concepts of risk, return, and investment decision-making.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Financial Management Overview: Finance Function, Finance Related disciplines, Scope of Financial Management, Emerging Role of Financial management	**3 Hours**

MODULE II

Time value of Money: Introduction to Time value of Money, Compounding Technique, Present value and	**3 Hours**

Future Value, and its Practical Implications (Basic Problem)	

MODULE III

Capital Budgeting: Introduction, Nature of capital Budgeting, Techniques of Capital budgeting (NPV, IRR, PI, ARR) (Basic Problems)	**3 Hours**

MODULE IV

Financial Statement Analysis: Balance Sheet, P&L, Cashflow, Comparative and Common Size Statement Analysis.	**3 Hours**

COURSE OUTCOMES

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

CO1	Demonstrate a comprehensive understanding of the fundamental concepts of financial management and illustrate the role of financial decision-making in achieving business goals.	CL2
CO2	Apply the concept of time value of money to evaluate present and future values of cash flows.	CL3
CO3	Identify the long-term investment decisions using capital budgeting techniques.	CL3
CO4	Make use of financial statements to assess the financial health, performance, and decision-making potential of an organization.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE) Multiple Choice Questions only	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will be set in the form of Multiple-Choice Questions only
- The total marks of SEE shall be 100

REFERENCE BOOKS:

1. Financial Management, Khan M. Y.& Jain P. K, TMH, 8/e
2. Financial Management, Prasanna Chandra, TMH, 9/e.
3. Corporate Finance, Aswath Damodaran, latest edition

REFERENCE WEB LINKS AND VIDEO LECTURES (E - E-RESOURCES):

1. https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLyqSpQzTE6M9DKhN7z2fOpKTJWu-639_P
2. https://www.youtube.com/watch?v=5Y8Lfsreeck&list=PL7DC83C6B3312DF1E
3. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_V-ZKxRKrxgFyOutPJpoLFBaQMOpK-

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BIOLOGY FOR IT ENGINEERS

(Effective from the Academic Year 2025 – 26)

IV SEMESTER

Course Code	BBS409TC	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	2:0:0:3	SEE Marks	50
Total Hours of Pedagogy	28L	Exam Hours	03

CREDITS – 2

COURSE PREREQUISITES:

- Basic Concepts of Biology

COURSE OBJECTIVES:

This course will enable students to:

- Familiarize the students with the basic biological concepts and their engineering applications.
- Enable the students with an understanding of biodesign principles to create novel devices and structures.
- Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- Motivate the students to develop interdisciplinary vision of biological engineering

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Application of Biomolecules: Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production, lipids in biodiesel and detergents production, food processing, detergent formulation and textile processing	**7 Hours**

MODULE II

Nature-Bioinspired Materials and Mechanisms: Echolocation: Ultrasonic sensors in robotics and autonomous vehicles, Photosynthesis: Bio-inspired CO_2 capture technologies, Bird flying, Aerodynamics design of aircraft and drones, Lotus leaf effect: Self-cleaning coatings for glass and solar panels, Plant burrs: Development of Velcro, Shark skin: Drag-reducing surfaces in swimsuits and submarines, Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).	**7 Hours**

MODULE III

Adaptation of Anatomical Principles For Bioengineering Design Brain as a CPU system: Signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease, Eye as a Camera system: Retinal prosthetics and bionic eyes, Heart as a pump system: Artificial heart and ventricular assist devices (VADs), Lungs as purification system: Artificial respiration and ventilator design Kidney as a Filtration System: hemodialysis machines	**7 Hours**

MODULE IV

Trends In Bioengineering: Muscular and Skeletal Systems as scaffolds, scaffolds and tissue engineering, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bio concrete. Bioremediation. Biomining.	**7 Hours**

COURSE OUTCOMES

CO1	Understand the role of biomolecules in engineering applications	CL2
CO2	Identify bioinspired principles from nature to develop innovative engineering solutions	CL2
CO3	Explain the analogy between human organ systems and engineered systems.	CL2
CO4	Outline significant technological trends shaping modern bioengineering	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I

M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022 Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
3. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

4. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
5. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019.
6. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
7. Biomaterials Science and Tissue Engineering: Principles and Methods, by Bikramjit Basu, Cambridge IISc Series.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=96-u9s6D16k
2. https://www.youtube.com/watch?v=4_emccqgYMs
3. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
4. https://onlinecourses.nptel.ac.in/noc22_cs29/preview

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DATA SCIENCE AND VISUALIZATION

(Effective from the Academic Year 2025 - 26)

V SEMESTER

Course Code	BIS501G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamental knowledge of mathematical concepts, analytical skills, and programming.
- Usage of IDEs like Jupyter Notebook/ PyCharm, VSCODE

COURSE OBJECTIVES:

This course will enable students to:

- Introduce data collection and pre-processing techniques for data science.
- Explore analytical methods for solving real-life problems through data exploration techniques.
- Illustrate different types of data and its visualization.
- Find different data visualization techniques and tools.
- Make use of datasets in implementing the data visualization techniques
- Integrate machine learning libraries and statistical tools suitable for the Data Science applications under consideration.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Data Science: Data Science Process, Overview of Data Preparation, Modeling, Difference between data science and data analytics, Statistics, Correlation, Simpson's Paradox, Correlation and	**10 Hours**

Causation, Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.	

MODULE II	
Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k- NN), k-means.	**10 Hours**

MODULE III	
Extracting Meaning from Data: Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters, Wrappers, Decision Trees, Random Forests. **Data Visualization and Data Exploration:** Introduction to Data Visualization, Importance of Data Visualization, Data Wrangling, Tools and Libraries for Visualization. **Comparison Plots:** Line Chart, Bar Chart and Radar Chart; Relation Plots: Scatter Plot, Bubble Plot, Correlogram and Heatmap; Composition Plots: Pie Chart, Stacked Bar Chart, Stacked Area Chart.	**10 Hours**

MODULE IV	
A Deep Dive into Matplotlib: Introduction, Overview of Plots in Matplotlib, Pyplot Basics: Creating Figures, Closing Figures, Format Strings, Plotting, Plotting Using pandas Data Frames, Displaying Figures, Saving Figures, Basic Text and Legend Functions: Labels, Titles, Text, Annotations, Legends, Basic Plots: Bar Chart, Pie Chart, Stacked Bar Chart, Stacked Area Chart, Histogram, Box Plot, Scatter Plot, Bubble Plot, Images: Basic Image Operations.	**10 Hours**

COURSE OUTCOMES

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

CO1	Apply basic concepts and principles related to data and statistical reasoning to solve simple analytical problems.	CL3
CO2	Make use of standard analytical approaches to examine data and derive meaningful observations.	CL3
CO3	Utilize appropriate techniques to process data and obtain useful information for analysis.	CL3
CO4	Apply Matplotlib and Pyplot functionalities to generate standard data visualizations for effective data presentation.	CL3

LABORATORY COMPONENTS

Exp. No.	**Experiment Description**	**Bloom's Taxonomy Level**

1.	a) Load the given dataset using **NumPy**. Compute the following statistical measures: Mean, Median, Variance, Standard Deviation. Also, demonstrate the following NumPy operations: Indexing, Slicing, Splitting, Iterating, Filtering, Sorting, Combining, and Reshaping. b) Load the same dataset using Pandas. Compute the following statistical measures: Mean, Median, Variance, Standard Deviation. Also, demonstrate the following NumPy operations: Indexing, Slicing, Iterating, Filtering, Sorting and Reshaping.	CL3
2.	For a given dataset stored in a .CSV file, perform the following visualizations using Matplotlib. a) Visualizing through a Line Plot b) Creating a Bar Plot c) Creating a Stacked Bar Plot to Visualize a Specified Parameter d) Comparing specific parameters using a Stacked Area Chart	CL3
3.	For a given dataset stored in a .CSV file, perform the following visualizations using Matplotlib. a) Box Plot to Visualize the given parameter b) Scatter Plot to Visualize Correlation c) Scatter Plot with Marginal Histograms d) Plotting Multiple Images in a Grid.	CL3
4.	For a given dataset stored in a .CSV file, implement and demonstrate the following visualizations using Seaborn. a) To generate surface temperature analysis Using heat map to find patterns.	CL3
5.	Implement the non-parametric Locally Weighted Regression algorithm to fit data points. Select appropriate data set for your experiment and draw graphs.	CL3
6.	Write a Python program to draw dot plots and heatmaps using the geoplotlib Library.	CL3
7.	Write a Python program using the Folium Package to perform the following tasks. a) Create a base map b) Add a circular marker with popup text. c) Add a simple marker for a parachute-style marker with pop-up text. d) Add a line to the map.	CL3
8.	a) Write a Python program to explain working with a Bokeh line graph using Annotations and Legends. b) Write a Python program for plotting different types of plots using Bokeh.	CL3
9.	Write a program to parse HTML using Beautiful Soup/equivalent Library support.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks

1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (30%)			**Assignment (20%)**	**Practical (50%)**	
I	**II**	**III**			
Syllabus Coverage			**Syllabus Coverage**		**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**	**100%**
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE, is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all five modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Vijay Kotu, Bala Deshpande. “Data Science Concepts and Practice”, Elsevier, M.K. Publishers.
2. Doing Data Science, Cathy O’Neil and Rachel Schutt, O'Reilly Media, Inc O'Reilly Media, Inc, 2013.
3. Samir Madhavan. “Mastering Python for Data Science”, PACKT Publishing.
4. Data Visualization workshop, Tim Grobmann and Mario Dobler, Packt Publishing, ISBN 9781800568112.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.oreilly.com/library/view/doing-data-science/9781449363871/toc01.html
3. http://book.visualisingdata.com/

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DATA COMMUNICATIONS AND NETWORKING

(Effective from the Academic Year 2025 - 26)

V SEMESTER

Course Code	BIS502G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamentals of data structures and algorithms

COURSE OBJECTIVES:

This course will enable students to:

- Illustrate concepts of data communication, Fundamentals of the Physical layer, and Data link layer
- Explain routers, IP, and Routing Algorithms in the network layer
- Discuss transport layer services and understand UDP and TCP protocols
- Demonstration of application layer protocols

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Data Communications: Networks, Network Types, Internet history, Standards and administration. OSI and TCP/IP model. **Physical Layer:** Data and Signals, Periodic analog signals, Digital signals, Transmission impairment, Data rate limits, Performance**,** Pulse Code Modulation, Line coding techniques (NRZ, Manchester, Differential Manchester, AMI, Pseudoternary)	**10 Hours**

MODULE II

Data-Link Layer: Introduction to Data-Link Layer, Error detection and correction, Block coding, Cyclic codes, Checksum**.** **Media Access Control:** Random access, Controlled access, Channelization.	**10 Hours**
MODULE III	
The Network Layer - What's Inside a Router?: Switching, Output processing, Where does queuing occur? IPv6, A brief foray into IP security.**Routing Algorithms:** Link-State (LS) routing algorithm, Distance-Vector (DV) routing algorithm. **Intra-AS Routing in the Internet:** RIP and OSPF. Inter/AS Routing: BGP. **Transport Layer - Introduction and Transport-Layer Services:** Relationship between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing: Connectionless transport: UDP, UDP Segment structure, UDP checksum **Principles of Reliable data transfer:** Building a reliable data transfer protocol, Pipelined reliable data transfer protocols, Go-Back-N, Selective repeat	**10 Hours**
MODULE IV	
Application Layer - Principles of Network Applications: Network Application Architectures, Processes communicating, transport services available to applications, Transport services provided by the Internet, Application-Layer Protocols. **Web and HTTP:** Overview of HTTP, Non-persistent and Persistent connections, HTTP Message format, User-Server interaction: Cookies, Web caching, The Conditional GET**.** **File Transfer:** FTP commands & replies, Electronic mail in the internet: SMTP, Comparison with HTTP, mail message format, Mail access protocols, DNS. **The Internet's Directory Service:** Services Provided by DNS, Overview of how DNS works, DNS records and messages.	**10 Hours**

COURSE OUTCOMES

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

CO1	Make use of the basic fundamentals of data communication and networking in understanding real-time applications.	CL3
CO2	Analyze Error detection and correction techniques, flow control, and error control.	CL4
CO3	Examine Routers, IP Routing algorithms in the network layer, and analyze transport layer services and infer UDP and TCP protocols.	CL4

CO4	Discuss the principles of the application layer protocol and the importance of web and HTTP.	CL2

LABORATORY COMPONENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Write a program for error detecting code using CRC-CCITT (16 bits) using JAVA.	CL3
2.	Write a program for congestion control using a leaky bucket algorithm using a JAVA program.	CL3
3.	Write a socket programming in JAVA using TCP -iterative client-server program.	CL3
4.	Write a socket programming in JAVA using UDP - an iterative client-server program.	CL3
5.	Implement a computer network using a hub and a switch using GNS3.	CL3
6.	Analyze a router in a computer network using GNS3.	CL3
7.	Analyze the dynamic host configuration protocol (DHCP) using GNS3.	CL3
8.	Analyze the computer network design using two routers in GNS3.	CL3
9.	Analyze the design of VLANs using GNS3.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.

- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE, is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all five modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)

- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw-Hill, Indian Edition
2. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson, 2017.
3. Larry L Peterson and Brusce S Davie, Computer Networks, Fifth edition, ELSEVIER
4. Andrew S Tanenbaum, Computer Networks, Fifth edition, Pearson
5. Mayank Dave, Computer Networks, Second edition, Cengage Learning

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://archive.nptel.ac.in/courses/106/105/106105183/
2. https://onlinecourses.nptel.ac.in/noc21_cs18/preview
3. https://www.eecis.udel.edu/~bohacek/videoLectures/ComputerNetworking/ComputerNetworking_v2.html

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AUTOMATA THEORY AND COMPUTABILITY

(Effective from the Academic Year 2025 – 26)

V SEMESTER

Course Code	BIS503T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Discrete Mathematics and Data Structures

COURSE OBJECTIVES:

This course will enable students to:

- Introduce core concepts in Automata and Theory of Computation.
- Identify different Formal Language Classes and their Relationships.
- Learn concepts of Grammars and Recognizers for different formal languages.
- Prove or disprove theorems in automata theory using their properties.
- Determine the decidability and intractability of Computational problems.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Automata Theory: Overview and Applications of Automata Theory, The Central Concepts of Automata Theory. **Finite Automata:** Deterministic Finite Automata; Nondeterministic Finite Automata, Equivalence of Deterministic and Nondeterministic Finite Automata, An Application of Finite Automata: Text Search, Finite Automata with Epsilon-transitions.	**10 Hours**

MODULE II	
Regular Expressions and Languages: Regular Expressions; Finite Automata and Regular Expressions; Applications of Regular Expressions. **Properties of Regular Languages:** Proving Languages Not To Be Regular; Closure Properties of Regular Languages; Equivalence and Minimization of Automata.	**10 Hours**
MODULE III	
Context-Free Grammars and Languages: Context-Free Grammars; Parse Trees; Applications of Context-Free Grammars, Ambiguity in Grammars and Languages. **Pushdown Automata:** Definition of the Pushdown Automaton (PDA); The Languages of a PDA; Design of PDA; Equivalence of PDA's and CFG's – Conversion from CFG to PDA and vice versa; Deterministic Pushdown Automata. **Properties of Context-Free Languages:** Normal Forms for Context-Free Grammars; The Pumping Lemma for Context-Free Languages; Closure Properties of Context-Free Languages.	**10 Hours**
MODULE IV	
Introduction to Turing Machines: The Turing Machine – Notation for the Turing Machine, Instantaneous Descriptions for Turing Machines, Design of Turing Machines, Transition Diagrams for Turing Machines, The Language of a Turing Machine, Programming Techniques for Turing Machine **Variants of Turing Machines:** Nondeterministic Turing Machine, Multi-Tape Turing Machine, The Model of Linear Bounded Automaton. **Decidability and Recursively Enumerable Languages:** Halting Problem of Turing Machine, The Post Correspondence Problem. **Complexity:** Growth Rate of Functions, The Classes of P and NP, Quantum Computation - Quantum Computers, Church-Turing Thesis.	**10 Hours**

COURSE OUTCOMES

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

CO1	Apply the central concepts of automata theory to solve the different finite automata and determine the equivalence between different models of finite automata.	CL3
CO2	Build the regular expression for the formal languages and show the equivalence between finite automata and regular expressions.	CL3
CO3	Construct the context-free grammars, pushdown automata for the formal languages and illustrate the equivalence between pushdown automata and context-free grammar.	CL3
CO4	Design Turing machines to solve the computational problems and explain the concepts of decidability and undecidability.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	**Semester End Exam (SEE) (50%)**
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.

- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman: Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education.
2. K L P Mishra, N Chandrasekaran, 3rd Edition, Theory of Computer Science, PhI.
3. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson Education, 2012/2013
4. Michael Sipser: Introduction to the Theory of Computation, 3rd Edition, Cengage Learning, 2013
5. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw–Hill Publishing Company Limited, 2013
6. Basavaraj S. Anami, Karibasappa K G, Formal Languages and Automata Theory, Wiley India, 2012
7. C K Nagpal, Formal Languages and Automata Theory, Oxford University Press, 2012.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - E-RESOURCES):

1. https://nptel.ac.in/courses/106106049
2. https://www.jflap.org/

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DATABASE MANAGEMENT SYSTEM

(Effective from the Academic Year 2025 – 26)

V SEMESTER

Course Code	BIS504T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:5	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Data Structures and Knowledge of Set Theory

COURSE OBJECTIVES:

This course will enable students to:

- Provide a Strong foundation in Database concepts, Technology and practice
- Practice SQL programming through a variety of database problems
- Demonstrate the use of concurrency and transactions in database
- Design and build database applications for real world problems.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Databases: Overview, Characteristics of database approach, Actors on the Scene, Workers behind the Scene, Advantages of using the DBMS approach, History of database applications (Self Study). **Database System Concepts and Architecture:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.	**10 Hours**

Data Modeling Using the Entity-Relationship (ER) Model: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Relationship Types of Degree Higher than Two, Examples. **Relational Database Design by ER-to-Relational Mapping:** Relational Database Design using ER-to-Relational mapping.	
MODULE II	
The Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Basic SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL. **SQL Advances Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.	**10 Hours**
MODULE III	
Basics of Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form. **Relational Database Design Algorithms and Further Dependencies:** Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design.	**10 Hours**
MODULE IV	
Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. **Concurrency Control Techniques**: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering. **Introduction to NOSQL Databases:** Emergence of NOSQL Systems, Characteristics of NOSQL Systems, Categories of NOSQL Systems.	**10 Hours**

COURSE OUTCOMES

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

CO1	Discuss the fundamental concepts of database technology and illustrate the designing of a conceptual database using the Entity Relationship (ER) model.	CL3
CO2	Examine the concepts of relational algebra and illustrate the application of Structured Query Language in database application development.	CL3

CO3	Apply the functional dependency to measure the appropriateness of attribute groupings into relation schemas and discuss the process of normalization with its algorithms.	CL3
CO4	Identify the basic concepts and theory needed for transaction processing, concurrency control in database applications.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	**Semester End Exam (SEE) (50%)**
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
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8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database Management Systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill.
3. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
4. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=6Iu45VZGQDk&list=PLBlnK6fEyqRi_CUQ-FXxgzKQ1dwr_ZJWZ
2. https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh
3. https://www.youtube.com/watch?v=OMwgGL3lHlI&list=PLBlnK6fEyqRiyryTrbKHX1Sh9luYI0dhX
4. https://onlinecourses.nptel.ac.in/noc23_cs41/preview
5. https://www.youtube.com/watch?v=kBdlM6hNDAE&list=PLxCzCOWd7aiFAN6I8CuViBuCdJgiOkT2Y

DATABASE MANAGEMENT SYSTEM LABORATORY

(Effective from the Academic Year 2025 - 26)

V SEMESTER

Course Code	BIS505L	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	03

CREDITS – 1

COURSE PREREQUISITES:

- Knowledge of Programming

COURSE OBJECTIVES:

This course will enable students to:

- Foundation knowledge in database concepts, technology, and practice to groom students into well-informed database application developers.
- Strong practice in SQL programming through a variety of database problems.
- Develop database applications using front-end tools and back-end DBMS.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Consider developing a database application for storing and managing the data related to a Company. The company is organized into departments. Each department has a unique name, a unique number, and a particular employee who manages the department. We keep track of the start date when that employee began managing the department. A department may have several locations, and it controls a number of projects, each of which has a unique name, a unique number, and a single location. The database will store each Employee's name, Aadhaar number, address, salary, sex, and birth date. An employee is assigned to one department, but may work on several projects, which are not necessarily controlled by the same department. It is required to keep track of the current

	number of hours per week that an employee works on each project, as well as the direct supervisor of each employee (who is another employee). The database will keep track of the dependents of each employee for insurance purposes, including each dependent's first name, sex, birth date, and relationship to the employee. i. Analyse the given cases and identify the suitable entities, relations, and cardinalities. ii. Design the ER Model for the analysis done above. iii. Convert the ER model into an appropriate relational schema and create the relevant schemas using SQL. iv. Perform the basic DML activities – INSERT, DELETE, and UPDATE into the obtained relations. Insert a minimum of 10 records into each relation. v. Demonstrate the result of the queries specified by the instructor using the concepts of SQL.
2.	Consider developing a database application for storing and managing the transactions done in a library. The Library Management System (LMS) programme shall maintain program-wise details of the books housed in the library. Each program shall have a specific identifier, name, and address. The LMS keeps track of books, with each book having a specific identifier, title, publisher, and publication year. Each book is published by a specific publisher who have a specific name, address, and phone number. The details of the authors of the book – identifier of the book written by them and the author's name is also stored in the LMS. The statistics of the number of copies of each book is maintained for each program. The transaction of lending a book is tracked using the card number, out date, and the due date. The book lending is maintained for each program. i. Analyse the given cases and identify the suitable entities, relations, and cardinalities. ii. Design the ER Model for the analysis done above. iii. Convert the ER model into an appropriate relational schema and create the relevant schemas using SQL. iv. Perform the basic DML activities – INSERT, DELETE, and UPDATE into the obtained relations. Insert a minimum of 10 records into each relation. v. Demonstrate the result of the queries specified by the instructor using the concepts of SQL.
3.	Develop a database application for the college to store academic information. The application should store the information of the student who has a University Seat Number (USN), name, phone number, and gender. The sections and semester are tracked using SemSec, which contains a unique identifier for each section. For creating a class, any number of students can be allotted to any number of sections. Each semester offers a list of courses. Each course contains a code, title, semester, and credit details. The Internal Assessment marks of the students belonging to the class need to be maintained, where data related to Test1, Test2, Test3 and Final marks shall be stored. i. Analyse the given cases and identify the suitable entities, relations, and cardinalities. ii. Design the ER Model for the analysis done above. iii. Convert the ER model into an appropriate relational schema and create the relevant schemas using SQL. iv. Perform the basic DML activities – INSERT, DELETE, and UPDATE into the obtained relations. Insert a minimum of 10 records into each relation. v. Demonstrate the result of the queries specified by the instructor using the concepts of SQL.
4.	Consider developing a database application for storing and managing the data of Canara Bank. The application should provide a mechanism to hold the data of the Branch and the Customers. Each branch shall have a unique

	identifier, branch name, city and total assets present in the branch. Each branch shall maintain accounts of different customers and provide loans to the customers. Each account shall have a number, its type, and indicate the branch to which it belongs. Further, the account shall also indicate the current balance it holds. Each customer shall have a name, an identifier, street and city. As depositors, any number of customers can perform deposits to any number of accounts in a given branch. A branch can provide a loan to the customers, for which it maintains the loan number, branch name, amount, and the ID of the customer to whom the loan was provided. i. Analyse the given cases and identify the suitable entities, relations, and cardinalities. ii. Design the ER Model for the analysis done above. iii. Convert the ER model into an appropriate relational schema and create the relevant schemas using SQL. iv. Perform the basic DML activities – INSERT, DELETE, and UPDATE into the obtained relations. Insert a minimum of 10 records into each relation. v. Demonstrate the result of the queries specified by the instructor using the concepts of SQL.
5.	Consider developing a database application for Airline Management. The database shall provide the mechanism to store information related to aircraft, Employees, Certification, and flights. The data pertaining to the ID, name, and cruising range of each aircraft needs to be stored. Every employee shall have their ID, name, and salary stored into the database. The information about the availability of a flight between two cities need to be managed by storing the information such as the Flight number, Source, Destination, Distance, Departure Time, Arrival Time and the cost. For flying any specific aircraft, the employee must obtain the necessary certification, the information of which needs to be saved. Any number of employees can be certified to fly any type of aircraft. i. Analyse the given cases and identify the suitable entities, relations, and cardinalities. ii. Design the ER Model for the analysis done above. iii. Convert the ER model into an appropriate relational schema and create the relevant schemas using SQL. iv. Perform the basic DML activities – INSERT, DELETE, and UPDATE into the obtained relations. Insert a minimum of 10 records into each relation. v. Demonstrate the result of the queries specified by the instructor using the concepts of SQL.

COURSE OUTCOMES

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

CO1	Demonstrate an understanding of the ER model by designing the ER diagram for any given case.	CL6
CO2	Design a relational schema for any given ER model and create the relational database using SQL.	CL6
CO3	Demonstrate a basic understanding of SQL by creating, inserting, and updating values into the database.	CL3
CO4	Apply the advanced concepts of SQL for querying and evaluate the results obtained for any given queries.	CL5

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**

	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot

- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the course instructor may change the same according to the course requirements, with the approval of the HoD
- Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

REFERENCE BOOKS:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database Management Systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill.
3. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
4. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

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1. https://www.youtube.com/watch?v=6Iu45VZGQDk&list=PLBlnK6fEyqRi_CUQ-FXxgzKQ1dwr_ZJWZ
2. https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh
3. https://www.youtube.com/watch?v=OMwgGL3lHlI&list=PLBlnK6fEyqRiyryTrbKHX1Sh9luYI0dhX
4. https://onlinecourses.nptel.ac.in/noc23_cs41/preview
5. http://vlabs.iitkgp.ernet.in/se/4/

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INFORMATION STORAGE AND MANAGEMENT

(Effective from the Academic Year 2025 – 26)

V SEMESTER

Course Code	BIS506E1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:5	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Data Communication, Database Management System, and Data Warehousing

COURSE OBJECTIVES:

This course will enable students to:

- Describe the importance of data, information, and storage infrastructure.
- Review the evolution of storage technology.
- Understand the key management requirements of a storage system.
- Introduce RAID and intelligent storage systems.
- Explain the storage networking technologies and virtualization.
- Discuss CAS, business continuity, backup, and recovery.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure. **Data Center Environment:** Application, Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application Requirements and Disk Performance.	**10 Hours**

Data Protection: RAID - RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares.	

MODULE II

Fibre Channel Storage Area Networks: Fibre Channel: Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Fabric Services, Switched Fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN. **Network-Attached Storage (NAS):** General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance, File Level Virtualization.	**10 Hours**

MODULE III

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. **Backup and Archive:** Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Data Archive, Archiving Solution Architecture.	**10 Hours**

MODULE IV

Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas, Local Replication in a Virtualized Environment. **Remote Replication:** Modes of Remote Replication, Remote Replication Technologies, Three Site Replication, Data Migration Solutions, Remote replication and migration in a virtualized environment.	**10 Hours**

COURSE OUTCOMES

CO1	Identify the storage requirements for the applications and illustrate the importance of RAID for the effective maintenance and protection of data.	CL3
CO2	Discuss the different storage networking technologies, including FC SAN and NAS.	CL2
CO3	Explain the process of business continuity, backup, and recovery to ensure information availability for vital business operations.	CL2
CO4	Explain the process of replication to minimize the risk of business disruption and ensure business continuity.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20

2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Somasundaram Gnanasundaram, Alok Shrivastava: "Information Storage and Management", 2nd Edition, EMC Education Services, Wiley India Publications. ISBN: 978-81-265-3750-1
2. Ulf Troppens, Rainer Erkens, and Wolfgang Muller: Storage Networks Explained, Wiley India, 2003.
3. Robert Spalding: Storage Networks, The Complete Reference, Tata McGraw-Hill, 2003.
4. Richard Barker and Paul Massiglia: Storage Area Networks Essentials: A Complete Guide to Understanding and Implementing SANs, Wiley India, 2002.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://nptel.ac.in/courses/106108058

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OBJECT ORIENTED MODELING AND DESIGN

(Effective from the Academic Year 2025 – 26)

V SEMESTER

Course Code	BIS506E2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:5	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Object-Oriented Concepts and Software Engineering

COURSE OBJECTIVES:

This course will enable students to:

- Introduce the concept and terms used in Object Oriented Modelling
- Understand the importance of the object-oriented approach and UML notation
- Develop an understanding of Class, State, and Interaction models
- Design and develop a system with an object-oriented approach.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Advanced Class Modeling: Advanced object and class concepts, Association ends, N-ary associations, Aggregation, Abstract classes, Multiple inheritance, Metadata, Reification, Constraints, Derived data, Packages. **State Modeling:** Events, States, Transitions and Conditions, State diagrams, State diagram behavior. **Advanced State Modeling:** Nested state diagrams, Nested states, Signal generalization, Concurrency, Relation of class and state models.	**10 Hours**

MODULE II	
Interaction Modeling: Use case models, Sequence models, Activity models. **Advanced Interaction Modeling:** Use case relationships, Procedural sequence models, Special constructs for activity models. **Process Overview:** Development stages, Development life cycle. **System Conception:** Devising a system concept, Elaborating a concept, Preparing a problem statement.	**10 Hours**
MODULE III	
Domain Analysis: Overview of analysis, Domain class model, Domain state model, Domain interaction model, Iterating the analysis. **Application Analysis:** Application interaction model, Application class model, Application state model, Adding operations. **System Design:** Overview of system design, Estimating performance, Making a reuse plan, Breaking a system into sub-systems, Identifying concurrency, Allocation of sub-systems, Management of data storage, Handling global resources, Choosing a software control strategy, Handling boundary conditions, Setting the trade-off priorities, Common architectural styles, Architecture of the ATM system as the example.	**10 Hours**
MODULE IV	
Class Design: Overview of class design, Bridging the gap, Realizing use cases, Designing algorithms, Recursing downwards, Refactoring, Design optimization, Reification of behavior, Adjustment of inheritance, Organizing a class design, ATM example. **Implementation Modeling:** Overview of implementation, Fine-tuning classes, Fine-tuning generalizations, Realizing associations, Testing.	**10 Hours**

COURSE OUTCOMES

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

CO1	Design class and state models for a given problem.	CL3
CO2	Analyze and build interaction models for the system to be developed.	CL3
CO3	Perform the domain and application analysis and illustrate the system design.	CL3
CO4	Discuss the implementation of the system using Object object-oriented approach.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30

	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	**Semester End Exam (SEE) (50%)**
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
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c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, 2nd Edition, Pearson Education, 2005.
2. Grady Booch et al, Object-Oriented Analysis and Design with Applications -, 3rd Edition, Pearson, 2007.
3. Mark Priestley, Practical Object-Oriented Design with UML - 2nd Edition, Tata McGraw-Hill, 2003.
4. K. Barclay, J. Savage, Object-Oriented Design with UML and JAVA, Elsevier, 2008.
5. Booch, G., Rumbaugh, J., and Jacobson, The Unified Modeling Language User Guide - 2nd Edition, Pearson, 2005.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/
2. https://onlinecourses.nptel.ac.in/noc20_cs59/preview

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DATA WAREHOUSING AND DATA MINING

(Effective from the Academic Year 2025 – 26)

V SEMESTER

Course Code	BIS506E3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:5	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Database Management System

COURSE OBJECTIVES:

This course will enable students to:

- Describe the multi-dimensional data models and OLAP.
- Discuss the importance of data in the knowledge discovery process.
- Explain the process of frequent itemset generation and association rule mining.
- Discuss the concepts of classification and illustrate different classification algorithms.
- Understand the concepts of clustering and apply various clustering methods to cluster the given data.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Data Warehousing & Modeling: Data Warehouse: Basic Concepts – What is a Data Warehouse?; Differences between Operational Database Systems and Data Warehouses; But, Why Have a Separate Data Warehouse?; Data Warehousing: A multitiered Architecture; Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse; Extraction, Transformation, and Loading; Metadata Repository;	**10 Hours**

Data Warehouse Modeling: Data Cube and OLAP – Data Cube: A Multidimensional Data Model; Stars, Snowflakes and Fact Constellations: Schemas for Multidimensional Data Models; Dimensions: The Role of Concept Hierarchies; Measures: Their Categorization and Computation; Typical OLAP Operations. **Data Warehouse Implementation:** Efficient Data Cube Computation: An Overview; Indexing OLAP Data: Bitmap Index and Join Index; Efficient Processing of OLAP Queries; OLAP Server Architectures: ROLAP versus MOLAP versus HOLAP.	
MODULE II	
Data Mining: Introduction - What is Data Mining?; Motivating Challenges; The Origins of Data Mining; Data Mining Tasks; Data - Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity – Basics, Similarity, and Dissimilarity between Simple Attributes, Dissimilarities between Data Objects, Similarities between Data Objects, Examples of Proximity Measures. **Association Analysis:** Basic Concepts and Algorithms - Problem Definition; Frequent Itemset Generation; Rule Generation; Compact Representation of Frequent Itemsets; Alternative Methods for Generating Frequent Itemsets; FP-Growth Algorithm; Evaluation of Association Patterns – Objective Measures of Interestingness.	**10 Hours**
MODULE III	
Classification: Preliminaries; General Approach to Solving a Classification Problem; Decision Trees Induction; Method for Comparing Classifiers; Rule-Based Classifier; Nearest Neighbor Classifiers; Bayesian Classifiers.	**10 Hours**
MODULE IV	
Cluster Analysis: Basic Concepts and Methods – Cluster Analysis: What is Cluster Analysis?, Requirements for Cluster Analysis, Overview of Basic Clustering Methods; Partitioning Methods - k-Means: A Centroid-Based Technique, k-Medoids: A Representative Object-Based Technique; Hierarchical Methods; Density-Based Methods; Evaluation of Clustering.	**10 Hours**

COURSE OUTCOMES

CO1	Explain the data warehouse with its implementation and OLAP technology for understanding the knowledge discovery process.	CL2
CO2	Illustrate the importance of data for the mining process and construct the association rules for discovering important relationships hidden in large data sets.	CL3
CO3	Make use of the different classification techniques to solve diverse applications.	CL3
CO4	Apply the concepts of clustering for understanding data and solving different practical problems.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks

1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression, 2014.
3. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012.
4. Michael.J.Berry, Gordon.S.Linoff: Mastering Data Mining, Wiley Edition, Second Edition, 2012.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

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JAVA PROGRAMMING FOR MOBILE APPLICATIONS

(Effective from the Academic Year 2025 - 26)

V SEMESTER

Course Code	BIS506E4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:5	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basic Knowledge of Java Programming
- Installation procedure of the Android Studio software

COURSE OBJECTIVES:

- Learn to set up an Android application development environment
- Illustrate user interfaces for interacting with apps and triggering actions
- Interpret tasks used in handling multiple activities
- Identify options to save persistent application data
- Appraise the role of security and performance in Android applications

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Getting Started with Android Programming: What is Android? Features of Android, Android Architecture, obtaining the required tools, Launching your first android application **Activities, Fragments and Intents:** Understanding activities, linking activities using intents, fragments	**10 Hours**

MODULE II

Getting to know the Android User Interface: Understanding the Components of a Screen: Views and View Groups, Frame Layout, Linear Layout, Table Layout, Relative Layout, Scroll View. **Adapting to Display Orientation**: Anchoring Views. **Utilizing the Action Bar**: Adding Action Items to the Action Bar	**10 Hours**

MODULE III

Designing User Interface with Views: **Using Basic Views**: Text View – Button, Image Button, Edit Text, Checkbox, Toggle Button, Radio Button and Radio Group Views, Progress Bar View. **Using Picker Views:** Time Picker View, Date Picker View. **Using List Views to Display Long Lists**: List View, Using the Spinner View.	**10 Hours**

MODULE IV

Displaying Pictures and Menus with Views: Using Image Views to Display Pictures: Image View, Image Switcher, Grid View. **Using Menus with Views**: Creating the Helper Methods, Options Menu, Context Menu. **Using WebView**: Web View. **Data Persistence: Saving and Loading User Preferences:** Accessing Preferences Using an Activity, Programmatically Retrieving and Modifying the Preference Values.	**10 Hours**

COURSE OUTCOMES

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

CO1	Illustrate the architecture of Android and current trends in mobile operating systems.	CL2
CO2	Apply suitable software tools and APIs for the development User Interface of a particular mobile application.	CL3
CO3	Apply intents and broadcast receivers in an Android application.	CL3
CO4	Develop a design for mobile applications for specific requirements.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE, is conducted towards the end of the semester/course, whichever is earlier.

The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all five modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. J. F. DiMarzio, Beginning Android Programming with Android Studio, 4th Edition, 2017
2. John Horton, Android Programming for Beginners, 1st Edition, 2015
3. Dawn Griffiths & David Griffiths, Head First Android Development, O"Reilly, 1st Edition, 2015

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.tutorialspoint.com/android.
2. http://developer.android.com/guide/index.html.
3. http://developer.android.com/reference/packages.html.
4. http://developer.android.com/guide/components/fundamentals.html.
5. http://developer.android.com/guide/topics/ui/index.html.
6. http://developer.android.com/guide/topics/ui/declaring-layout.html.

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RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS

(Effective from the Academic Year 2025 – 26)

V SEMESTER

Course Code	BBS508AK	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	16L	Exam Hours	01

CREDITS – 1

COURSE PREREQUISITES:

- A foundational understanding of research and knowledge of research problem formulation, familiarity with academic ethics.
- Basic understanding of statistics and data analysis, ability to search and evaluate academic sources, basic writing and communication skills, critical thinking skills, time management skills and awareness of ethical considerations in research.

COURSE OBJECTIVES:

This course will enable students to:

- Understand the basic concepts, principles, and types of research methodologies
- Collect, analyze, and interpret data using relevant techniques.
- Ethically conduct research and adhere to academic integrity.
- Communicate research findings effectively through written and oral presentations.
- Understand the intellectual property rights and the types of IPR.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Research Methodology and Literature Review **Introduction to Research Methodology:** Meaning of research, Objectives of research, Types of research,	**4 Hours**

Importance of scientific research in decision making, Defining the research problem, techniques involved in defining a problem**.** Research Design: Meaning of research design, need for research design, Features of good design. **Literature Review:** Significance of literature review, Sources for literature: Books, Journals, Proceedings, Thesis and Dissertations. Online databases: Web of Science, Google and Google Scholar. Quality research papers**.** Research metrics: Citation, Citation Index, Impact Factor, H-index, i10-index, Google index and their significance. **Ethics in Research:** Ethics with respect to research, ethical principles, the importance of adhering to ethical norms in research, research misconducts, plagiarism, penalties for plagiarism, publication ethics, conflict of interest, publication misconduct, violation of publication ethics and authorships, identification of publication misconduct, complaints and appeals (examples) and Open Access Publishing.	
MODULE II	
Data Collection, Analysis and Report Writing **Data Collection:** Introduction, collection of primary data: observation method, questionnaires and case study method, collection of secondary data, Selection of an appropriate method for data collection. **Data Analysis**: Introduction, Data analysis process, Types of data analysis, Methods of data analysis: Qualitative analysis, Quantitative analysis. Tools for data analysis. **Report Writing:** Effective technical writing, Steps for writing a report, structure of the research report, method of writing a research article (manuscript)/ research report, crafting effective project proposals, Paper writing for National and international journals, submitting papers to journals (Scopus Indexed Journals, Science Citation Indexed journals), preparation of effective slides, pictures, and graphs for presentation.	**4 Hours**
MODULE III	
Intellectual Property Rights, Patents and Industrial Designs: **Intellectual Property Rights**: Introduction to intellectual property and intellectual property rights, objectives of IPR, History of IPR in India, Role of WIPO and WTO in IPR establishments, Types of Intellectual property rights. **Patents:** Introduction to patent, need and importance of a patent, requirements of patent, types of patents, few famous examples of patent, patentable and non-patentable items, Duration, limitations of a patent, the Indian Patent Act-1970, Rights associated with patents, Enforcement of patent rights, Patent infringements. Case Studies on Patents**:** Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent **Industrial Designs:** Design introduction, Features of Design, Design law 2000, Registration of Design, Need for registration of Design, Procedure for registration of Design, Infringement of Design. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.	**5 Hours**
MODULE IV	
Copyrights, Trademarks and Geographical Indications: **Copyrights:** Introduction to copyright, characteristics of copyright, copyright-National Vs international,	**4 Hours**

Indian copyright Act-1957, Indian perspective on copyright, Term/duration of copyright, registration of copyright, copyright symbol, procedure of copyright certification, benefits of copyright registration, copyright infringement, limitations of copyright. **Trademarks:** Introduction to Trademark, signs which may serve as Trademarks, functions of Trademark, Essential features of Trademark, Types of Trademark, the validity of the trademark, Unfair competition, Trademark Act 1999, Infringement of Trademark, Famous case law: Coca-Cola Company vs. Bisleri International Pvt. Ltd. **Geographical Indications:** Introduction to G.I, History of G.I, G.I Act 1999, Registration of G.I, Registration process of G.I, Duration of G.I Tag, Infringement of G.I, Some important G.I Tags.	

COURSE OUTCOMES

CO1	Comprehend the process of research methodology to define a research problem.	CL2
CO2	Understand the analytical tools for the analysis and interpretation of data.	CL2
CO3	Illustrate the significance of Intellectual property rights and of research projects for economic growth and social benefits.	CL2
CO4	Demonstrate the copyright laws, subject matters of copyrights and Trademarks.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05

2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

a. Theory SEE will be conducted, with common question papers for the subject (Duration 01 hour)

b. The question paper will have 50 questions. Each question is set for 02 marks.

c. The student has to answer all the questions, selecting one full question from each module.

REFERENCE BOOKS:

1. Kothari C R and Gaurav Garg, Research Methodology Methods and Techniques, Fourth Edition by, New Age International, 2019.
2. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.
3. Pratim Ray, Partha "A Guide to Research and Publication Ethics" First edition, New Delhi Publishers c2022.
4. Deborah E Bouchoux, Intellectual Property Rights by CENGAGE Learning.
5. Rupinder Tewari and Mamta Bhardwa, Intellectual Property A Primer for Academia.
6. David V. Thiel “Research Methods for Engineers” Cambridge University Press, 978-1-107-03488-4.
7. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
8. Acharya N K, Intellectual Property Rights, Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://youtu.be/oPXyj3mAEKg
3. https://youtu.be/E2gGF1rburw
4. https://www.youtube.com/watch?v=VzIgPfAd0Fs&list=RDCMUCLVol4Vq_9CKVYNv4tDZhXw&start_radio=1&rv=VzIgPfAd0Fs&t=0

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BIG DATA ANALYTICS

(Effective from the Academic Year 2025 - 26)

VI SEMESTER

Course Code	BIS601G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamental knowledge of Database Management Systems and any Programming Language.

COURSE OBJECTIVES:

This course will enable students to:

- Understand the need for Big Data, challenges, and different analytical architectures.
- Demonstrate the installation and understanding of Hadoop Architecture and its ecosystems.
- Explore the use of NoSQL data storage in different Big Data architectural management.
- Show the processing of Big Data with Advanced architectures like Hive, Pig, Cassandra, and Spark.
- Describe graphs and streaming data in Spark.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies. **Introduction to Hadoop:** Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn.	**10 Hours**

MODULE II	
Hadoop Distributed File System Basics: HDFS Design Features, Components, HDFS User Commands. **NoSQL Big Data Management, MongoDB and Cassandra**: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks. MongoDB Databases, Cassandra Databases.	**10 Hours**
MODULE III	
Hive: Architecture, Hive Data Types and File Formats, Hive Data Model, Hive Integration and Workflow Steps, Hive Built-in Functions, HiveQL **Pig:** Apache Pig – Grunt Shell, Installing Pig, Pig Latin Data Model, Pig Latin, and Developing Pig Latin Scripts. **PostgreSQL:** Introduction to PostgreSQL - What Is PostgreSQL?, The PostgreSQL Architecture, Basic PSQL Commands, Creating the Sample Database, Data Interfacing.	**10 Hours**
MODULE IV	
Spark and Big Data Analytics: Introduction, Spark, Data Analysis with Spark, Programming using RDD and MLIB, Data ETL, Introduction to Analytics, Reporting and Visualizing.	**10 Hours**

COURSE OUTCOMES

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

CO1	Explain the key concepts of big data analytics, including data architecture, data sources, storage, preprocessing, and real-world applications.	CL2
CO2	Apply HDFS commands and NoSQL tools like MongoDB and Cassandra to store, manage, and process big data using distributed architecture.	CL3
CO3	Apply data processing using Hive, Pig, and PostgreSQL to manage, query, and interface with big data in distributed environments.	CL3
CO4	Use Apache Spark and MLlib to perform big data analytics, ETL operations, and visualize analytical results through reports.	CL3

LABORATORY COMPONENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Develop a MapReduce program to calculate the frequency of a given word in a given file.	CL3
2.	Develop a MapReduce program to find the maximum temperature in each year.	CL3
3.	Create a MongoDB database called university and a collection named students. Add at least five student records with fields like name, roll_no, branch, and marks. Display all student records and show only the name and branch fields. Retrieve the records of students based on a condition applied	CL3

	to the marks field. Update the marks of a student using their roll_no and change the branch of a student using their name. Finally, delete a student record based on a condition applied to the marks field, and delete another student using their roll_no.	
4.	Create a MongoDB database and write queries to group and count data using aggregation. Use sorting and limiting to organize results. Also, apply text search, filters, indexing, joins, and date queries to work with and combine data.	CL3
5.	Create a database named university. In this database, create a table students(id INT, name STRING, age INT, department STRING, cgpa FLOAT). Load data into the table from a local CSV file. Then perform the following Hive operations: • Display all student records. • Show the names of students with a CGPA greater than 8. • Count the number of students in each department. • Display student names in uppercase using built-in functions. • Create a view named high_cgpa_students to list students with a CGPA greater than 9. • Query the view and then drop it.	CL3
6.	Create two tables in Hive: sales(sale_id INT, product_id INT, region STRING, amount FLOAT, sale_date STRING) and products(product_id INT, product_name STRING, category STRING). Partition the sales table by region and bucket it by sale_id into 4 buckets. Load data from local files and perform the following Hive operations: • Join sales and products to display product name, sale amount, and region. • Show the total sales amount grouped by region. • Use a window function to rank products by sales amount within each region. • Display the average, minimum, and maximum sale amount per product category using aggregate functions.	CL3
7.	Create a Pig Latin script to calculate the average rating for each genre in the movie's dataset. Then filter to keep only genres with an average rating above a certain threshold, and display the genre and average rating. Join the movies and directors' datasets on director ID. Sort the joined data by director name ascending and movie release year descending. Finally, compute and show the minimum, maximum, and count of movie ratings.	CL3
8.	Create a Pig Latin script to join the movies and directors' datasets on the director ID. Sort the joined data by director name ascending and movie release year descending. Finally, compute and show the minimum, maximum, and count of movie ratings.	CL3
9.	Create a PostgreSQL table named employees with columns for employee ID, name, department, and salary. Write PostgreSQL queries to insert new employee records, update an employee's salary, delete an employee by their ID, and select all employees from a specific department.	CL3

10.	Create an RDD from a text file and write Spark code to perform transformations that filter out lines containing a specific word, then map the remaining lines to their word counts. Finally, collect and display the results.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10

8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode:

- The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)
- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE, is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Raj Kamal and Preeti Saxena, “Big Data Analytics Introduction to Hadoop, Spark, and Machine Learning”, McGraw-Hill Education, 2018, ISBN: 9789353164966, 9353164966
2. Matthew, N., & Stone, R. *Beginning databases with PostgreSQL: From novice to professional* (2nd ed.). Apress.
3. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1st Edition, Pearson Education, 2016. ISBN13: 978- 9332570351
4. The PostgreSQL Global Development Group. (n.d.). PostgreSQL 16.9 documentation. Retrieved from https://www.postgresql.org/docs/16/index.html

5. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Inc., Fourth Edition, 2015.
6. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
7. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
8. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011
9. Alan Gates, "Programming Pig", O'Reilley, 2011

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc20_cs92/

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INFORMATION RETRIEVAL

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS602T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- The Knowledge of Discrete Mathematical Structures

COURSE OBJECTIVES:

This course will enable students to:

- Understand basic concepts, retrieval models, and the retrieval process.
- Apply query languages, feedback techniques, and evaluate retrieval systems.
- Implement text processing, indexing, and distributed retrieval techniques.
- Explore user interfaces, web search, and visualization in information retrieval.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction: Motivation, Basic concepts, Past, present, and future, The retrieval process. **Modeling**: Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, Models for browsing. **Retrieval Evaluation**: Introduction, Retrieval performance evaluation, Reference collections.	**10 Hours**

MODULE II

Query Languages: Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. **Query Operations**: Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis. **Text and Multimedia Languages and Properties:** Introduction, Metadata, Text, Markup languages, Multimedia.	**10 Hours**

MODULE III

Text Operations: Introduction, Document preprocessing, Document clustering, Text compression, Comparing text compression techniques. **Indexing and Searching**: Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching; Structural queries; Compression. **Parallel and Distributed IR**: Introduction, Parallel IR, Distributed IR.	**10 Hours**

MODULE IV

User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting points, Query specification, Context, Using relevance judgments, Interface support for the search process. **Searching the Web**: Introduction, Challenges, Characterizing the web, Search engines, Browsing, Meta searchers, Finding the needle in the haystack, Searching using Hyperlinks.	**10 Hours**

COURSE OUTCOMES

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

CO1	Understand and differentiate various information retrieval models and evaluate their performance.	CL2
CO2	Apply query languages, relevance feedback, and metadata for effective information retrieval.	CL3
CO3	Implement text preprocessing, indexing strategies, and distributed retrieval mechanisms.	CL3
CO4	Analyze web-based search systems and design user-friendly interfaces for enhanced information access.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)		**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)	**Assignment/**	

I	II	III	Activities (40%)	
Syllabus coverage			Syllabus Coverage	Syllabus Coverage
35%	35%	30%	100%	100%
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling to 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice i.e. 4A or 4B. Each question may contain a maximum of three sub-questions (i.e. 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice i.e. 5A or 5B. Each question may contain a maximum of three sub-questions (i.e. 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. An Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Cambridge University Press, 2009
2. Modern Information Retrieval, Ricardo Baeza Yates, Berthier Ribeiro Neto ,Pearson, 1999
3. Information Retrieval Algorithms and Heuristics, David A. Grossman, Ophir Frieder, Springer, 2nd Edition, 2004

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.geeksforgeeks.org/what-is-information-retrieval/
2. https://www.youtube.com/watch?v=mxq4TkuVrWA

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ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS603T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of Mathematics concepts like probability and statistics.
- Basic knowledge of data science.

COURSE OBJECTIVES:

This course will enable students to:

- Gain a historical perspective of AI and its foundations.
- Understand the basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- Describe Artificial Intelligence and Machine Learning algorithms and evaluate their performance.
- Understand a range of machine learning algorithms along with their strengths and weaknesses.
- Illustrate AI and ML algorithm and their use in appropriate applications.
- Describe the applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.
- Apply the classification, clustering, and regression-based machine learning algorithms to solve real-time problems.
- Apply the algorithms to a real-world problem, optimize the models learned, and report on the expected accuracy that can be achieved by applying the models.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I	
Introduction to AI: Intelligent systems, Foundations and Sub area of AI, Applications, Tic-Tac-Toe Game playing, Currents trend and developments of AI. **Problem Solving:** General problem solving, Characteristics of problem, Heuristic search techniques, Generate and Test, Hill Climbing, Best First Search, A* Algorithm, Constraint satisfaction, Problem reduction. **Knowledge representation:** Representation and Mapping, Approaches to Knowledge Representation.	**10 Hours**
MODULE II	
Introduction: Machine Learning, Types of Machine Learning, Main challenges of Machine Learning, Testing and Validating, Performance measures. **Concept Learning:** Concept Learning tasks, Concept Learning as search, Find S algorithm, Version Spaces and Candidate Elimination algorithm. **Decision Tree Learning:** Introduction, Decision tree representation, Appropriate problems, ID3 algorithm.	**10 Hours**
MODULE III	
Ensemble learning and Random Forests: Voting Classifiers, Bagging and Pasting, Boosting, Stacking, Random Forest. **Artificial Neural Network:** Introduction, Neural Network representation, Appropriate problems, Perceptron, Back propagation algorithm. **Bayesian Learning:** Introduction, Bayes theorem, Bayes theorem and concept learning, Minimum description length principle, Naive Bayes Classifier, Text Classification, Bayesian Belief Network (BBN).	**10 Hours**
MODULE IV	
Unsupervised Learning Techniques: Introduction to clustering, Clustering algorithms: K-Means. **Instance-Based Learning**: Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Linear SVM classification, Nonlinear SVM classification, SVM Regression. **Reinforcement Learning**: Introduction, The learning task, Q-Learning.	**10 Hours**

COURSE OUTCOMES		
Upon completion of this course, the students will be able to:		
CO1	Apply AI principles and heuristic search techniques to solve structured problems such as Tic-Tac-Toe and constraint satisfaction tasks.	CL3
CO2	Illustrate machine learning methods, including Find-S, Candidate Elimination, and ID3 algorithms, for effective concept learning and decision-making.	CL3
CO3	Demonstrate predictive models using ensemble techniques like Random Forests and neural networks, including Perceptron and Backpropagation, for solving complex real-world problems.	CL3

CO4	Apply clustering, instance-based, and reinforcement learning techniques such as K-Means, k-Nearest Neighbor, and Q-Learning to analyze and solve diverse data-driven problems.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**

- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Saroj Kaushik, Artificial Intelligence, 2011 Cengage Learning India Pvt. Ltd, 1St Edition, ISBN: 978-81-315-1099-9.
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &TensorFlow, O'Reilly Media Publications, 3rd Edition, 2022, ISBN: 978-93-5542-198-2.
3. Tom M Mitchell, Machine Learning, McGraw Hill Education Pvt. Ltd, 1st Edition, 2017, ISBN: 978-1-25-909695-2.
4. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd., 3rd Edition, 2014, ISBN: 978- 81-203-5078-6.
5. Elaine Rich, Kevin Kand S B Nair, "Artificial Intelligence", 3rd Edition, McGraw-Hill Education, 2017

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
2. https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
3. https://nptel.ac.in/courses/106/105/106105077/
4. https://www.javatpoint.com/history-of-artificial-intelligence
5. https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence
6. https://techvidvan.com/tutorials/ai-heuristic-search/
7. https://www.analyticsvidhya.com/machine-learning/
8. https://www.javatpoint.com/decision-tree-induction
9. https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/mldecision-tree/tutorial/
10. https://www.javatpoint.com/unsupervised-artificial-neural-networks

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COMPILER DESIGN

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS604E1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Automata Theory and Computability

COURSE OBJECTIVES:

- Study the concepts of language translation and the phases of compiler design
- Understand the need for lexical analyzers in compilers
- Inculcate knowledge of a parser by designing an LL and an LR parser
- Learn intermediate code generation using syntax-directed translation schemes
- Identify the various optimization techniques for designing various optimizing compilers

TEACHING - LEARNING STRATEGY:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Compilers: Language Processors, The Structure of a Compiler: Lexical Analysis – Syntax Analysis – Semantic Analysis – Intermediate Code Generation – Code Optimization – Code Generation – Symbol Table Management – The Grouping of Phases into Passes – Compiler Construction Tools. **Lexical Analysis:** The Role of the Lexical Analyzer: Tokens, Patterns and Lexemes – Attributes for Tokens – Lexical Errors, Input Buffering: Buffer Pairs - Sentinels, Specification of Tokens: Regular Expressions – Regular Definitions – Extensions of Regular Expressions, Recognition of Tokens: Transition Diagrams – Recognition of Reserved Words and Identifiers – Recognition of Numbers – Architecture of a Transition	**10 Hours**

Diagram Based Lexical Analyzer, The Lexical Analyzer Generator-Lex: Use of Lex – Structure of Lex Programs – Conflicts Resolution in Lex, The Lookahead Operator, Design of a Lexical Analyzer Generator: The Structure of the Generated Analyzer – Pattern Matching Based on NFA's – DFA's for Lexical Analyzers. **Syntax Analysis:** Introduction: The Role of the Parser – Representative Grammars – Syntax Error Handling – Error Recovery Strategies, Writing a Grammar: Lexical versus Syntax Analysis - Eliminating Ambiguity – Elimination of Left Recursion – Left Factoring – Non Context-Free Language Constructs, Top-Down Parsing: Recursive-Descent Parsing – FIRST and FOLLOW – LL(1) Grammars – Nonrecursive Predictive Parsing	
MODULE II	
Bottom-Up Parsing: Reductions – Handle Pruning – Shift-Reduce Parsing – Conflicts during Shift-Reduce Parsing, Introduction to LR Parsing–Simple LR: Need of LR Parsers – Items and the LR(0) Automaton – The LR Parsing Algorithm – Constructing SLR Parsing Tables, More Powerful LR Parsers: Canonical LR(1) Items – Constructing LR(1) Sets of Items – Canonical LR(1) Parsing Tables – Constructing LALR Parsing Tables, Parser Generators: The Parser Generator-Yacc – Using Yacc with Ambiguous Grammars – Creating Yacc Lexical Analyzers with Lex – Error Recovery in Yacc.	**10 Hours**
MODULE III	
Syntax Directed Translation: Syntax-Directed Definitions: Inherited and Synthesized Attributes – Evaluating an SDD at the Nodes of a Parse Tree, Evaluation Orders for SDDs: Dependency Graphs – Ordering the Evaluation of Attributes – S-Attributed Definitions – L-Attributed Definitions – Semantic Rules with Controlled Side Effects, Applications of Syntax Directed Translation: Construction of Syntax Trees – The Structure of a Type, Syntax Directed Translation Schemes: Postfix Translation Schemes – Parser Stack Implementation of Postfix SDTs – SDTs with Actions Inside Productions. **Intermediate Code Generation:** Variants of Syntax Tree: Directed Acyclic Graphs for Expressions, Three Address Code: Addresses and Instructions – Quadruples – Triples – Static Single Assignment Form, Translation of Expressions: Operations within Expressions – Incremental Translation – Addressing Array Elements – Translation of Array References, Control Flow: Boolean Expressions – Short Circuit Code – Flow of Control Statements – Control Flow Translation of Boolean Expressions - Switch Statements: Translation of Switch-Statements – Syntax Directed Translation of Switch-Statements.	**10 Hours**
MODULE IV	
Code Generation: Issues in the Design of a Code Generator: Input to the Code Generator – The Target Program – Instruction Selection – Register Allocation – Evaluation Order, The Target Language: A Simple Target Machine Model – Program and Instruction Costs, Basic Blocks and Flow Graphs: Basic Blocks – Next Use Information – Flow Graphs – Representation of Flow Graphs - Loops, Optimization of Basic Blocks: The DAG representation of Basic Blocks – Finding Local Common Subexpressions – Dead Code Elimination – The Use of Algebraic Identities, A Simple Code Generator: Register and Address Descriptors – The Code Generation Algorithm.	**10 Hours**

Machine Independent Optimizations: The Principal Sources of Optimization: Causes of Redundancy – Semantics Preserving Transformations – Global Common Subexpressions – Copy Propagation – Dead Code Elimination – Code Motion – Induction Variables and Reduction in Strength.	

COURSE OUTCOMES

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

CO1	Understand the different phases of compiler design techniques and analyze the working of a lexical analyzer in the design of compilers.	CL4
CO2	Build a syntax analyzer using top-down and bottom-up approaches	CL3
CO3	Develop syntax-directed translation for a given grammar, and explain the intermediate code representation.	CL3
CO4	Illustrate the code generation of compilers, and identify the different optimization techniques for designing optimized compilers.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02

6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Aho, Lam, Sethi and Ullman, Compilers – Principles, Techniques and Tools, Second Edition, Pearson Education, 2014.
2. Kenneth C Louden, Compiler Construction – Principles and Practice, First edition, PWS Publishing, 1997.
3. Charles N Fischer, Ron K Cytron, Richard J LeBlanc Jr.- Crafting a Compiler, Pearson Education, 2010.
4. K L P Mishra and N Chandrasekaran, Theory of Computer Science – Automata, Languages and Computation, Third edition, Prentice Hall of India, New Delhi, India, 2008.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/playlist?list=PLxCzCOWd7aiEKtKSIHYusizkESC42diyc
2. https://www.youtube.com/watch?v=OQCjakjCJu4
3. https://www.youtube.com/playlist?list=PLBlnK6fEyqRjT3oJxFXRgjPNzeS-LFY-q
4. https://www.youtube.com/playlist?list=PL1QH9gyQXfguPNDTsnG90W2kBDQpYLDQr
5. https://www.youtube.com/playlist?list=PLXj4XH7LcRfC9pGMWuM6UWE3V4YZ9TZzM
6. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
7. https://nptel.ac.in/courses/106104123

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OPERATIONS RESEARCH

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS604E2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Discrete Mathematics and Algorithms

COURSE OBJECTIVES:

- Understand the methodology of Operations Research problem solving
- Formulate the optimization problem as a linear programming problem
- Solve optimization problems using the simplex and dual simplex methods
- Apply game theory for decision-making problems
- Formulate and solve transportation and assignment problems

TEACHING - LEARNING STRATEGY:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Operations Research: The History of Operations Research, Definitions of Operations Research, Features of Operations Research Approach, Methodology of Operations Research, Applications of Operations Research, Computer Software for Operations Research. **Linear Programming – Model Formulation:** Introduction, Structure of Linear Programming (LP) Model, Advantages of using Linear Programming, Limitations of Linear Programming, General Mathematical Model of Linear Programming Problem, Guidelines on Linear Programming Model Formulation, Examples of LP Model Formulation.	**10 Hours**

Linear Programming – Graphical Method: Introduction, Important Definitions, Graphical Solution Methods of LP Problems, Special Cases in Linear Programming.	
MODULE II	
Linear Programming – Theory of Simplex Method: Introduction, Canonical Form of an LP Problem, Slack and Surplus Variables, Reduction of Feasible Solution to a Basic Feasible Solution, Improving a Basic Feasible Solution. **Linear Programming – Simplex Algorithm and Types:** Introduction, Standard form of an LP Problem, Simplex Algorithm (Maximization Case), Simplex Algorithm (Minimization Case), Two-Phase Method, Big-M Method, Some Complications and their Resolution, Types of Linear Programming Solutions. **Bounded Variables LP Problems:** Introduction, Solving Bounded Variables LP Problems using Simplex Algorithm.	**10 Hours**
MODULE III	
Duality in Linear Programming: Introduction, Formulation of Dual Linear Programming Problem, Standard Results on Duality, Managerial Significance of Duality, Advantages of Duality. **Dual-Simplex Method:** Introduction, Dual-Simplex Algorithm, Solving LPP using Dual-Simplex Method. **Theory of Games:** Introduction, Two-Person Zero-Sum Games, Pure Strategies (Minimax and Maximin Principles): Games with Saddle Point, Mixed Strategies: Games without Saddle Point, The Rules (Principles) of Dominance, Solution Methods for Games without Saddle Point: Algebraic Method - Arithmetic Method - Matrix Method - Graphical Method - Linear Programming Method.	**10 Hours**
MODULE IV	
Transportation Problems: Introduction, Mathematical Model of Transportation Problem, The Transportation Algorithm, Methods for Finding Initial Solution, Test for Optimality, Variations in Transportation Problem, Maximization Transportation Problem. **Assignment Problems:** Introduction, Mathematical Models of Assignment Problem, Solution Methods of Assignment Problem, Variations of the Assignment Problem, Travelling Salesman Problem.	**10 Hours**

COURSE OUTCOMES

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

CO1	Explain the importance of operations research by formulating an LPP model for real-world problems and solve it using the graphical and analytical methods.	CL3
CO2	Explain the essence of the simplex method and solve the various LP problems by using appropriate optimization techniques.	CL3
CO3	Make use of the dual simplex method to solve the various LP problems and apply the game theory concepts to the decision-making problems.	CL3
CO4	Solve the transportation and assignment problem and obtain the optimal solution.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,

a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. J K Sharma, Operations Research – Theory and Applications, Sixth Edition, New Delhi: Trinity Press, 2017.
2. S D Sharma, Operations Research, Kedar Nath Ram Nath Publishers.
3. P.K. Gupta and D.S. Hira, Operations Research, Seventh Edition, Published by S. Chand & Company Ltd, 2018.
4. S Kalavathy, Operations Research, Vikas Publishing House Pvt Limited, 2002.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=llqhvtxr9U4
2. https://www.youtube.com/watch?v=fgoaGxzwLqI
3. https://www.youtube.com/watch?v=01Iy2ZHOmNg
4. https://www.youtube.com/watch?v=fSuqTgnCVRg
5. https://www.youtube.com/watch?v=gLIZfHeQ9cQ
6. https://www.youtube.com/watch?v=rrfFTdO2Z7I
7. https://nptel.ac.in/courses/110106062
8. https://archive.nptel.ac.in/courses/111/107/111107128/

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SYSTEM MODELING AND SIMULATION

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS604E3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Discrete Mathematics

COURSE OBJECTIVES:

This course will enable students to:

- Outline the need for simulation in real-world phenomena and perform the simulation of different systems.
- Develop the appropriate statistical models by sampling the phenomenon of interest and analyzing the queueing models through simulation.
- Show the necessity of random numbers in the simulation of discrete systems and in the generation of a random variable with any desired probability distribution.
- Analyze the simulation data by effective input modeling.
- Illustrate the importance of verification and validation in decision-making based on simulation results.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Simulation: When Simulation is the Appropriate Tool, When Simulation is not Appropriate, Advantages and Disadvantages of Simulation, Systems and System Environment, Components of a System,	**10 Hours**

Discrete and Continuous Systems, Model of a System, Types of Models, Discrete-Event System Simulation, Steps in a Simulation Study. **Simulation Examples in a Spreadsheet:** Queueing Simulation in a Spreadsheet – Simulating a Single-Server Queue & Simulating a Queue with Two Servers.	
MODULE II	
General Principles: Concepts in Discrete-Event Simulation, The Event-Scheduling / Time-Advance Algorithm, Manual Simulation Using Event Scheduling – Single Channel Queue & Dump-Truck Problem, List Processing **Simulation Software:** Simulation in Java, Simulation in GPSS	**10 Hours**
MODULE III	
Random-Number Generation: Properties of Random Numbers; Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers. **Random-Variate Generation:** Inverse-Transform Technique, Acceptance-Rejection Technique.	**10 Hours**
MODULE IV	
Input Modeling: Data Collection, Identifying the Distribution with Data, Parameter Estimation, Goodness-of-Fit Tests, Fitting a Nonstationary Poisson Process, Selecting Input Models without Data. **Verification, Calibration, and Validation of Simulation Models:** Model Building, Verification, and Validation, Verification of Simulation Models, Calibration, and Validation of Models.	**10 Hours**

COURSE OUTCOMES

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

CO1	Illustrate the importance of system simulation and apply the different techniques to model the activities of a static system.	CL3
CO2	Demonstrate the modeling of complex systems by using discrete-event simulation and describe fundamental simulation packages for discrete-event simulation.	CL3
CO3	Analyze the properties of random numbers and illustrate some widely used techniques for generating random variates.	CL4
CO4	Examine the use of input models in simulation by choosing the statistical distributions and describe the verification, calibration, and validation process of the simulation models.	CL4

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20

2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010.
2. Lawrence M. Leemis, Stephen K. Park: Discrete–Event Simulation: A First Course, Pearson Education, 2006.
3. Averill M. Law: Simulation Modeling and Analysis, 4th Edition, Tata McGraw-Hill, 2007

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://nptel.ac.in/courses/112107220

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CRYPTOGRAPHY

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS604E4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of Cryptography Theories.

COURSE OBJECTIVES:

This course will enable students to:

- Provide a practical and theoretical knowledge of cryptography.
- Develop an understanding of different cryptographic protocols and techniques.
- Understand methods for authentication, access control, intrusion detection, and prevention.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques **Basic Concepts of Number Theory and Finite Fields:** Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Prime Numbers, Fermat's and Euler's theorem, discrete logarithm.	**10 Hours**

MODULE II

Symmetric Ciphers: Traditional Block Cipher structure, Data Encryption Standard (DES), The AES Cipher.	**10 Hours**

MODULE III	
Asymmetric Ciphers: Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	**10 Hours**

MODULE IV	
Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/ KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP	**10 Hours**

COURSE OUTCOMES

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

CO1	Apply classical encryption techniques such as substitution and transposition ciphers, and demonstrate understanding of number theory concepts.	CL3
CO2	Identify the design principles of symmetric key cryptography to encrypt and decrypt the information.	CL3
CO3	Apply the principles of asymmetric key cryptography for secure key exchange and data encryption.	CL3
CO4	Apply a pseudo-random sequence for constructing secure stream ciphers.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling to 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. William Stallings, Cryptography and Network Security: Principles and Practices, 7th Edition,2019.
2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C",Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.
3. Keith M Martin, “Everyday Cryptography”, Oxford University Press
4. Cryptography and Network Security, BehrouzA. Forouzan, TMH, 2007.
5. Cryptography and Network Security, Atul Kahate, TMH, 2003.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.geeksforgeeks.org/cryptography-and-network-security-principles
2. https://www.codingninjas.com/studio/library/cryptography-and-network-security

3. https://onlinecourses.swayam2.ac.in/cec24_cs16/course?&force_user=true
4. https://onlinecourses.nptel.ac.in/noc25_cs16/announcements?force=true

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INTRODUCTION TO DATA STRUCTURES

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS605Q1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Mathematics and C Programming

COURSE OBJECTIVES:

This course will enable students to:

- Explain the fundamental knowledge of various types of data structures and their applications essential for implementing solutions to problems.
- Implement linear data structures stacks, queues, and usage of stacks in various applications.
- Implement the operations of singly linked lists and circular singly linked lists.
- Identify and differentiate different types of binary trees and binary search trees data structures.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Pointers: Introduction, Pointer Concepts, Accessing Variables through Pointers, Pointer Applications, Dynamic Memory Allocation Functions. **Structures and Unions:** Introduction, Declaring Structures, Giving Values to Members, Structure Initialization, Comparison of Structure Variables, Arrays of Structures, Arrays within Structures, Nested Structures, Unions, Size of Structures. **Sorting:** Introduction, Bubble Sort, Selection Sort, Insertion Sort.	**10 Hours**

Searching: Introduction, Linear Search, Binary Search.	
MODULE II	
Stacks: Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks. **Queues:** Introduction, Queue Operations, Queue Implementation using Arrays, Different Types of Queues: Circular Queues, Double-Ended Queues, Priority Queues, Applications of Queues.	**10 Hours**
MODULE III	
Linked Lists: Introduction, Singly Linked List, Self-Referential Structures, Operations on Singly Linked Lists: Insert-Delete-Display, Implementation of Stacks and Queues using Linked List, Concatenate two Lists, Reverse a List without Creating a New Node, Static Allocation Vs Linked Allocation. **Circular Singly Linked List:** Introduction, Operations: Insert-Delete-Display.	**10 Hours**
MODULE IV	
Trees: Introduction, Basic Concepts, Representation of Binary Trees, Operations on Binary Trees: Insertion-Traversals-Searching-Copying a Tree, Binary Search Trees, Operations on Binary Search Trees: Insertion-Searching-Find Maximum and Minimum Value-Count Nodes, Expression Trees.	**10 Hours**

COURSE OUTCOMES

CO1	Apply the fundamental knowledge of pointers, structures, unions, and various types of data structures to solve the problems.	CL3
CO2	Make use of the stack and queue data structures for problem solving and identify their applications.	CL3
CO3	Develop and illustrate the various operations of singly linked lists and singly circular linked lists.	CL3
CO4	Identify different traversal methods of tree data structure to evaluate arithmetic expressions along with operations on Binary Search Trees.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II

	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. E Balagurusamy, "C Programming and Data Structures", 4th Edition, McGraw-Hill, 2007.
2. A M Padma Reddy, "Systematic Approach to Data Structures using C", 9th Revised Edition, Sri Nandi Publications, 2009.
3. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed., Universities Press, 2014.
4. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw-Hill, 2014.

5. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
6. Reema Thareja, Data Structures using C, 3rd Ed, Oxford Press, 2012.
7. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed., McGraw-Hill, 2013.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
2. https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
3. https://nptel.ac.in/courses/106/102/106102064
4. https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
5. https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
6. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
7. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html

SAHYADRI
COLLEGE OF ENGINEERING & MANAGEMENT
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INFORMATION MANAGEMENT SYSTEM

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS605Q2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of software engineering and project management

COURSE OBJECTIVES:

This course will enable students to:

- Understand the Role of information management systems in business and the decision-making process.
- Evaluate the role of the major types of information systems in a business environment and their relationship to each other.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Information Systems in Business: Introduction, The real world of Information Systems, Networks, What you need to know, The fundamental role of IS in business, Trends in IS, Managerial challenges of IT. **System Concepts:** A foundation, Components of an Information System, Information System Resources, Information System Activities, Recognizing Information Systems. **Fundamentals of strategic advantages:** Strategic IT, Competitive strategy concepts, The competitive advantage of IT, Strategic uses of IT, Building a customer-focused business, The value chain and strategic IS, Reengineering business processes, Becoming an agile company, Creating a virtual company, Building a knowledge-creating company.	**10 Hours**

MODULE II	
Enterprise Business Systems: Introduction, Cross-functional enterprise applications, Enterprise application integration, Transaction processing systems, Enterprise collaboration systems. **Functional Business Systems:** Introduction, Marketing systems, Manufacturing systems, Human resource systems, Accounting systems, Financial management systems.	**10 Hours**
MODULE III	
Customer relationship management: Introduction, what is CRM? The three phases of CRM, Benefits and challenges of CRM, Trends in CRM **Enterprise resource planning:** Introduction, What is ERP? Benefits and challenges of ERP, Trends in ERP. Supply Chain Management: Introduction, What is SCM? The role of SCM, Benefits and challenges of SCM, Trends in SCM.	**10 Hours**
MODULE IV	
Electronic commerce fundamentals: Introduction, The scope of ecommerce, Essential ecommerce, processes, Electronic payment processes. e-Commerce applications and issues: Ecommerce application trends, Business-to- Consumer e-commerce, Web store requirements, Business-to- Business e-commerce, e-commerce marketplaces, Clicks and bricks in ecommerce. **Decision support in business**: Introduction, Decision support trends, Decision support systems (DSS), Management Information Systems, Online analytical processing, Using DSS, Executive information systems, Enterprise portals and decision support, Knowledge management systems, Business and Artificial Intelligence (AI), An overview of AI, Expert systems.	**10 Hours**

COURSE OUTCOMES

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

CO1	Explain the fundamental concepts of Information Systems (IS) and their role in business, including the challenges and trends associated with IT and strategic uses for competitive advantage.	CL2
CO2	Describe the components and applications of cross-functional and functional business systems, such as marketing, manufacturing, human resources, accounting, and financial management systems.	CL2
CO3	Outline the principles and functionalities of customer relationship management (CRM), enterprise resource planning (ERP), and supply chain management (SCM), focusing on their benefits, challenges, and current trends.	CL2
CO4	Summarize the fundamental processes of e-commerce and decision support systems (DSS), including management information systems and knowledge management systems, and their impact on business operations.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions

c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. James A.O'Brien, George M Marakas, Management Information Systems, 7th Edition, Tata McGraw-Hill.
2. Kenneth C. Laudon and Jane P.Laudon, Management Information Systems, Managing the Digital Firm, 9th Edition, Pearson Education.
3. Steven Alter, Information Systems: The Foundation of E-Business, 4th Edition, Pearson Education.
4. W.S.Jawadekar, Management Information System, Tata McGraw-Hill.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - E-RESOURCES):

1. https://www.youtube.com/watch?v=omMOS7eaxrE
2. https://www.youtube.com/watch?v=zV73Kg4EH6Q
3. https://www.youtube.com/playlist?list=PLiBvgS5MGf06jcVDhYFuDI4ei23aFuhXY

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INTRODUCTION TO DATABASE MANAGEMENT SYSTEM

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS605Q3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Knowledge of Data Structures and Set Theory

COURSE OBJECTIVES:

This course will enable students to:

- Provide a Strong foundation in Database concepts, Technology, and practice
- Practice SQL programming through a variety of database problems
- Demonstrate the use of concurrency and transactions in a database
- Design and build database applications for real-world problems.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Databases: Overview, Characteristics of database approach, Actors on the Scene, Workers behind the Scene, Advantages of using the DBMS approach, History of database applications (Self Study). **Database System Concepts and Architecture:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.	**10 Hours**

Data Modeling Using the Entity-Relationship (ER) Model: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Relationship Types of Degree Higher than Two, Examples. **Relational Database Design by ER-to-Relational Mapping:** Relational Database Design using ER-to-Relational mapping.	

MODULE II

The Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Basic SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL.	**10 Hours**

MODULE III

Basics of Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.	**10 Hours**

MODULE IV

Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.	**10 Hours**

COURSE OUTCOMES

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

CO1	Discuss the fundamental concepts of database technology and illustrate the designing of a conceptual database using the Entity Relationship (ER) model.	CL3
CO2	Examine the concepts of relational algebra and illustrate the application of Structured Query Language in database application development.	CL3
CO3	Discuss the various types of normalization of relations.	CL3
CO4	Discuss the basic concepts and theory needed for transaction processing.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING				
Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database Management Systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill.
3. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
4. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=6Iu45VZGQDk&list=PLBlnK6fEyqRi_CUQ-FXxgzKQ1dwr_ZJWZ
2. https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh
3. https://www.youtube.com/watch?v=OMwgGL3lHlI&list=PLBlnK6fEyqRiyryTrbKHX1Sh9luYI0dhX
4. https://onlinecourses.nptel.ac.in/noc23_cs41/preview
5. https://www.youtube.com/watch?v=kBdlM6hNDAE&list=PLxCzCOWd7aiFAN6I8CuViBuCdJgiOkT2Y

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INTRODUCTION TO DATA SCIENCE

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BIS605Q4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of mathematical concepts, analytical skills and programming.

COURSE OBJECTIVES:

This course will enable students to:

- Develop relevant programming abilities.
- Demonstrate proficiency with statistical analysis of data.
- Develop the ability to build and assess data-based models.
- Learn to execute statistical analyses.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction: Statistics, Describing a Single Set of Data, Correlation, Simpson's Paradox, Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem. **Working with data:** Getting Data, stdin and stdout, Reading Files, Scraping the Web, Using APIs, Exploring the Data, Using NamedTuples, Dataclasses, Cleaning and Munging, Manipulating Data, Rescaling, An Aside: tqdm, Dimensionality Reduction.	**10 Hours**

MODULE II

Training: Gradient Descent, The Idea Behind Gradient Descent, Estimating the Gradient, Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Linear Regression, Multiple Regression.	**10 Hours**

MODULE III

Machine Learning and Deep Learning: Machine Learning, Modeling, What Is Machine Learning, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, Neural Networks, Perceptrons, Feed-Forward Neural Networks, Backpropagation.	**10 Hours**

MODULE IV

Network Analysis, Recommender System and MapReduce: Betweenness Centrality, Eigenvector Centrality, Directed Graphs and PageRank, Recommender Systems, Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering.	**10 Hours**

COURSE OUTCOMES

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

CO1	Identify and demonstrate data using visualization tools and apply statistical analysis methods to analyze and interpret data effectively in various real-world contexts.	CL3
CO2	Apply gradient descent optimization techniques to train linear regression, polynomial regression and logistic regression effectively.	CL3
CO3	Demonstrate the use of machine learning and deep learning models to implement efficient data-driven solutions for real-world problems.	CL3
CO4	Demonstrate knowledge about the recommender system, MapReduce, and understand the importance of data ethics.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III

		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling to 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e. 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Joel Grus, Data Science from Scratch-First Principles with Python, O' Reilly Publications, 2nd Edition, 2019, ISBN: 978-9352138326.
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow, O'Reilly Media Publications, 3rd Edition, 2022, ISBN: 978-93-5542-198-2.

3. Emily Robinson, Jacqueline Nolis, Build a Career in Data Science, Manning Publications, 1st Edition, 2020, ISBN: 9781638350156.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc21_cs69
2. https://onlinecourses.nptel.ac.in/noc22_cs32

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REACT JS FRONTEND WEB DEVELOPMENT

(Effective from the Academic Year 2025 - 26)

VI SEMESTER

Course Code	BIS608A1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Proficiency in JavaScript and familiarity with web development concepts.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce React JS for building dynamic user interfaces.
- Learn component-based architecture.
- Explore state management and React Hooks.
- Understand routing and navigation in React.
- Deploy React applications.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PRE-REQUISITE EXPERIMENTS

Exp. No.	Description
1.	Write a JavaScript program that uses variables, functions, arrays, conditionals, and loops.
2.	Create a basic HTML page that includes a form (input fields, buttons) and uses JavaScript to validate form data.
3.	Build a simple webpage using JavaScript and inline CSS to dynamically change styles and content.

LIST OF EXPERIMENTS

Exp. No.	Description

1.	Write a Program of React using JavaScript and HTML.
2.	Write a program to extract styles out of the component and use inline styling in MyComponent.
3.	Write a program to show error message in React.
4.	Write a use EFFECT Program.
5.	Write a program to create a form using React.
6.	Write a program of adding React Router in application.
7.	Write a program in React using Lazy Loading Method.
8.	Write a Program to test a basic small application, where your primary focus is to test an asynchronous method which fetches content for an index component, and shows a loading message.
9.	Use create-react-app to set up a new project. Edit the App.js file to include a stateful component with useState. Add an input field and a element that displays text based on the input. Dynamically update the content as the user types.

COURSE OUTCOMES

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

CO1	Develop basic React components using JavaScript, JSX, and HTML structure.	CL2
CO2	Apply state, props, hooks, and styling techniques to build interactive UI components.	CL3
CO3	Implement routing, lazy loading, and asynchronous operations in a React application.	CL3
CO4	Build, test, and deploy scalable React applications with dynamic data rendering.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

1. Beginning React JS Foundations Building User Interfaces with ReactJS: An Approachable Guide, Chris Minnick, Wiley publications , 2022.
2. Learning React Functional Web Development with React and Redux , Alex Banks, Eve Porcello · 2017

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=V9i3cGD-mts
2. https://youtu.be/PHaECbrKgs0
3. https://www.geeksforgeeks.org/state-management-with-usestate-hook-in-react/

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DEVOPS TESTING: UNIT TEST AND SERVER MONITORING

(Effective from the Academic Year 2025 - 26)

VI SEMESTER

Course Code	BIS608A2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Knowledge of basic testing concepts and DevOps tools.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce unit testing as part of the DevOps pipeline.
- Explore integration and end-to-end testing tools.
- Learn techniques for monitoring servers and applications.
- Analyze logs and set up alerts.
- Ensure application reliability through effective monitoring.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Write and run basic unit tests with Jest a. Initialize Node.js project and install Jest (npm install jest --save-dev) b. Write sample functions and unit tests in __tests__ folder c. Configure package.json test script d. Run tests using npm test e. Analyze test results

2.	Write and run unit tests with Mocha and Chai a. Install Mocha and Chai (npm install mocha chai --save-dev) b. Write unit test files c. Run tests using Mocha CLI d. View assertions and output
3.	Set up Selenium to perform browser-based integration tests a. Install Selenium WebDriver and browser drivers. b. Write basic test scripts to open web pages and check elements. c. Run tests locally and verify results
4.	Set up Cypress for end-to-end testing of web applications a. Install Cypress (npm install cypress --save-dev) b. Write test specs for web UI interactions c. Run tests via Cypress Test Runner d. Analyze test dashboard
5.	Setting Up Server Monitoring Using Nagios a. Install Nagios Core on a Linux server b. Configure hosts and services to monitor (e.g., HTTP, SSH) c. Access Nagios web UI and verify monitored services
6.	Setting Up Server Monitoring Using Prometheus a. Install Prometheus server and node_exporter agent. b. Configure Prometheus to scrape node_exporter metrics. c. Access Prometheus web UI and query metrics
7.	Analyzing Logs Using ELK Stack – Installing Elasticsearch a. Download and install Elasticsearch b. Configure Elasticsearch.yml for basic setup c. Start service and verify cluster health
8.	Analyzing Logs Using ELK Stack – Setting Up Logstash and Kibana a. Install Logstash and configure input and output pipelines. b. Install Kibana and connect to Elasticsearch. c. Load sample logs and create dashboards
9.	Configure Nagios to send alerts on service failures a. Define contact details and notification commands. b. Set thresholds for alerts c. Simulate server downtime or service failure d. Verify email/SMS alerts are received
10.	Configure Prometheus Alertmanager to send alerts on critical metrics a. Install Alertmanager and configure alert rules in Prometheus

	b. Set up notification channels (email, Slack) c. Trigger alert conditions and verify alerts are received

COURSE OUTCOMES

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

CO1	Apply unit testing within the DevOps pipeline to improve code quality.	CL3
CO2	Experiment with integration and end-to-end testing tools for comprehensive validation.	CL3
CO3	Utilize monitoring techniques for servers and applications to ensure visibility and performance.	CL3
CO4	Solve reliability issues by analyzing logs, setting alerts, and implementing effective monitoring strategies.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.

- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

BOOKS:

1. Niall Richard Murphy et al, Site Reliability Engineering,2016.
2. Deepak Gaikwad, Viral Thakkar, “DevOps Tools from Practitioner's Viewpoint”, Wiley, 2019
3. Mark S. Merkow, “Practical Security for Agile and DevOps”, CRC Press Taylor & Francis, 2022

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.guru99.com/selenium-tutorial.html
2. https://prometheus.io/docs/introduction/overview/

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SCRUM FUNDAMENTALS

(Effective from the Academic Year 2025 - 26)

VI SEMESTER

Course Code	BIS608A3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24P	Exam Hours	02

CREDITS – 1

COURSE PREREQUISITES:

- Familiarity with Agile methodologies and project management basics.

COURSE OBJECTIVES:

This course will enable students to:

- Understand the principles of Scrum and Agile.
- Explore roles and responsibilities in Scrum.
- Learn to plan and conduct Scrum events.
- Manage sprints and backlogs effectively.
- Ensure continuous improvement through retrospectives.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

PREREQUISITE EXPERIMENTS

Exp. No.	Description
1.	Introduction to Agile Methodology
2.	Overview of Scrum Framework
3.	Introduction to Scrum Tools (Jira, Trello, Azure Boards)
4.	Writing Effective User Stories
5.	Basics of Project Planning and Estimation

LIST OF EXPERIMENTS

Exp. No.	Description
1.	Setting up a Scrum Project
2.	Creating and Managing a Product Backlog
3.	Writing and Splitting Epics into User Stories
4.	Planning and Starting a Sprint
5.	Estimating User Stories with Story Points
6.	Tracking Sprint Progress Using a Scrum Board
7.	Conducting Daily Scrum Meetings
8.	Monitoring Sprint Progress with a Burndown Chart
9.	Conducting Sprint Review Meetings
10.	Conducting Sprint Retrospectives

COURSE OUTCOMES

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

CO1	Set up a Scrum project and configure roles, artifacts, and workflows.	CL2
CO2	Create and manage a product backlog by writing and refining user stories and epics.	CL3
CO3	Apply sprint planning techniques, including story point estimation and sprint board setup.	CL3
CO4	Track and monitor sprint progress using Scrum artifacts and conduct Scrum ceremonies effectively.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.
- In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
- SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
- General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.
- The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

LEARNING RESOURCES:

1. "Scrum: The Art of Doing Twice the Work in Half the Time" by Jeff Sutherland.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://youtu.be/nuaZc5CDeMU
2. https://youtu.be/9TycLR0TqFA

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INVESTMENT MANAGEMENT

(Effective from the Academic Year 2025 – 26)

VI SEMESTER

Course Code	BBA608A4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12 L	Exam Hours	01

CREDITS – 1

COURSE PREREQUISITES:

- Basic understanding of mathematics.
- Basic understanding of investment and avenues of investment
- Familiarity with Excel or any spreadsheet software.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce students to the fundamentals of investment management.
- Familiarize students with various types of investment instruments.
- Explain the risks and returns associated with investments.
- Develop skills to evaluate investment options.
- Highlight the importance of financial planning.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Investment: Meaning and Importance of Investments, Investment vs. Speculation vs. Gambling, Types of Investment Instruments (Equity, Bonds, Mutual Funds). Basics of Stock Market Operations.	**3 Hours**

MODULE II

Risk and Return Analysis: Concept of Risk and Return, Types of Risks (Market Risk, Credit Risk, Liquidity Risk), Measuring Returns and Time Value of Money. **Excel Application:** Basic Risk and Return Metrics.	**3 Hours**

MODULE III

Mutual Fund: Concept of Mutual Fund, Types of Mutual fund (Equity Funds, Debt Funds, Hybrid Funds, Sectoral & Thematic Funds, and Index Funds), and Benefits of Mutual fund	**3 Hours**

MODULE IV

Basics of Portfolio Management: Introduction to Portfolio Management, Benefits of Diversification, and Constructing Simple Portfolios.	**3 Hours**

COURSE OUTCOMES

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

CO1	Understand the fundamental concepts of investment, its objectives, and the various investment avenues available, enabling informed decision-making for personal and institutional financial growth.	CL2
CO2	Analyze the relationship between risk and return for various investment options, and apply quantitative tools to measure risk, assess expected returns, and make sound investment decisions.	CL3
CO3	Understand the structure, types, and functioning of mutual funds, and evaluate their performance using key indicators to make informed investment decisions based on risk-return profiles.	CL2
CO4	Understand the fundamental principles of portfolio management, including diversification, asset allocation, and risk-return optimization, to construct and manage a basic investment portfolio.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE) Multiple Choice Questions only	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I

M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will be set in the form of Multiple-Choice Questions only
- The total marks of SEE shall be 100

REFERENCE BOOKS:

1. Frank K. Reilly: "Investment Analysis and Portfolio Management".
2. Prasanna Chandra: "Investment Analysis and Portfolio Management," Tata McGraw Hill, 3/e, 2010.
3. "Security Analysis" by Benjamin Graham and David Dodd.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://www.youtube.com/watch?v=HNPbY6fSeo8&t=100s
2. https://www.youtube.com/watch?v=qIw-yFC-HNU
3. https://www.youtube.com/watch?v=4IsMphnvsbE
4. https://www.youtube.com/watch?v=YrGTHaGflSA

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CLOUD COMPUTING AND SECURITY

(Effective from the Academic Year 2025 - 26)

VII SEMESTER

Course Code	BIS701G	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:4	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamental knowledge of databases, Operating Systems, and Networking.

COURSE OBJECTIVES:

This course will enable students to:

- Introduce the rationale behind the cloud computing revolution and the business Drivers.
- Understand various models, types, and challenges of cloud computing.
- Understand the design of cloud native applications, the necessary tools, and the design tradeoffs.
- Realize the importance of Cloud Virtualization, Abstractions, Enabling Technologies, and cloud security.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Distributed System Models and Enabling Technologies: Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency. **Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.	**10 Hours**

MODULE II

Cloud Platform Architecture over Virtualized Datacenters: Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management.	**10 Hours**

MODULE III

Cloud Security: Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud Security. **Cloud Security and Trust Management:** Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centers.	**10 Hours**

MODULE IV

Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments.	**10 Hours**

COURSE OUTCOMES

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

CO1	Describe various cloud computing platforms, service providers, and the significance of various types of virtualization.	CL3
CO2	Identify the architecture, delivery models, and industrial platforms for cloud computing-based applications.	CL3
CO3	Analyze the role of security aspects in cloud computing.	CL3
CO4	Demonstrate cloud applications in various fields using suitable cloud platforms.	CL3

LABORATORY CONTENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Creating a Virtual Machine: Configure and deploy a virtual machine with specific CPU and memory requirements in Google Cloud. OR Exploring AWS CloudShell and the AWS Cloud9 IDE	CL4
2.	Getting Started with Cloud Shell and gcloud: Discover the use of gcloud commands to manage Google Cloud resources from Cloud Shell. OR Working with Amazon S3 Orchestrating Serverless Functions with AWS Step Functions.	CL4
3.	Cloud Functions: Create and deploy a Cloud Function to automate a specific task based on a Cloud Storage event. OR Working with Amazon DynamoDB.	CL4

4.	App Engine: Deploy a web application on App Engine with automatic scaling enabled. OR Developing REST APIs with Amazon API Gateway.	CL4
5.	Cloud Storage: Qwikstart: Google Cloud Storage provides scalable and secure object storage for managing data, accessible via the Cloud Console or gsutil CLI. OR Creating Lambda Functions Using the AWS SDK for Python.	CL4
6.	Cloud SQL for MySQL: Discover how Google Cloud SQL for MySQL provide automated management and high availability for MySQL databases. OR Migrating a Web Application to Docker Containers.	CL4
7.	Cloud Pub/Sub: Experiment how Google Cloud Pub/Sub facilitates real-time messaging and communication between distributed applications. OR Caching Application Data with ElastiCache, Caching with Amazon CloudFronT, Caching Strategies.	CL4
8.	Multiple VPC Networks: Explore the benefits of using multiple VPC networks in Google Cloud for organizing and isolating resources. OR Implementing CloudFront for Caching and Application Security.	CL4
9.	Cloud Monitoring: Discover how Cloud Monitoring helps in tracking and analyzing the performance and health of cloud resources. OR Orchestrating Serverless Functions with AWS Step Functions.	CL4
10.	Kubernetes Engine: Qwik Start: Deploy a containerized application to a Kubernetes Engine cluster. OR Automating Application Deployment Using a CI/CD Pipeline.	CL4

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)			**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (30%)			

I	II	III	Assignment (20%)	Practical (50%)	
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

ASSESSMENT STRATEGY FOR LABORATORY

Assessment Mode:

- The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B)
- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments shall be scaled down to 15 marks (A)
- A Laboratory Test, similar to the SEE is conducted towards the end of the semester/course, whichever is earlier. The obtained marks are scaled down to 10 marks (B).

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**

- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice i.e. 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Kai Hwang, Geoffrey C Fox, and Jack J Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, Elsevier 2012
2. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, 2nd Edition, Elsevier 2018
3. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, Mastering Cloud Computing McGrawHill Education, 1st Edition, 2017
4. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Education, 2017.

Reference Web Links and Video Lectures (E-Resources):

1. https://freevideolectures.com/course/4639/nptel-cloud-computing/1.
2. https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
3. https://www.youtube.com/watch?v=EN4fEbcFZ_E

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SOFTWARE TESTING

(Effective from the Academic Year 2025 - 26)

VII SEMESTER

Course Code	BIS702T	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Software engineering and the C language

COURSE OBJECTIVES:

This course will enable students to:

- Differentiate the various testing techniques
- Analyze the problem and derive suitable test cases.
- Apply a suitable technique for designing of flow graph.
- Learn about automation testing and when to automate the application.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Basics of Software Testing: Basic definitions, Software Quality, Requirements, Behavior and Correctness, Correctness versus Reliability, Testing and Debugging, Test cases, Insights from a Venn diagram, Identifying test cases, Test-generation Strategies, Test Metrics, Error and fault taxonomies , Levels of testing, Testing and Verification, Static Testing. **Problem Statements:** Generalized pseudocode, the triangle problem, the NextDate function, the commission problem, the SATM (Simple Automatic Teller Machine) problem, the currency converter, Saturn windshield wiper.	**10 Hours**

MODULE II

Functional Testing: Boundary value analysis, Robustness testing, Worst-case testing, Robust Worst testing for triangle problem, NextDate problem and commission problem, Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations, Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations. **Fault Based Testing:** Overview, Assumptions in fault-based testing, Mutation analysis, Fault-based adequacy criteria, Variations on mutation analysis.	**10 Hours**
MODULE III	
Structural Testing: Overview, Statement testing, Programme testing, Condition testing, Path testing: DD paths, Test coverage metrics, Basis path testing, guidelines and observations, Data –Flow testing: Definition-Use testing, Slice-based testing, Guidelines and observations. **Test Execution**: Overview of test execution, from test case specification to test cases, Scaffolding, Generic versus specific scaffolding, Test oracles, Self-checks as oracles, Capture and replay.	**10 Hours**
MODULE IV	
Automation Testing: From Manual to Automation testing: First attempt records and playback, Difference between Manual and automated test, Exploratory testing. **Variety of tools**: Classification of tools, IDEs and Programming language, (unit) testing frameworks, BDD-style Frameworks. **Introduction to Web drivers:** First Steps, What is WebDriver? How WebDriver works? The history of Selenium, The tools you need to get started. Locating elements on a page: Locating one or more elements based on ID, class, or name, Fine-grained targeting using complex CSS selectors, Making pages amenable to element locating.	**10 Hours**

COURSE OUTCOMES

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

CO1	Summarize the concepts of testing and apply to derive different test cases	CL2
CO2	Interpret and compare the different testing techniques	CL2
CO3	Apply the appropriate testing techniques in classifying the problem	CL3
CO4	Evaluate the techniques and skills on how to use modern software testing tools to support software testing projects.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15

	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (30%)			**Assignment (20%)**	**Practical (50%)**	
I	**II**	**III**			
Syllabus Coverage			**Syllabus Coverage**		**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**	**100%**
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, the Question 1 shall be mandatory and can have any number of sub-questions each of 01-03 marks totaling to 20 covering all five modules
- In Part B, a student has to answer 4 FULL questions where,
  - e. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub questions
  - f. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub questions
  - g. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain choice i.e. 4A or 4B. Each question may contain a maximum of three sub questions (i.e. 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

h. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain choice i.e. 5A or 5B. Each question may contain a maximum of three sub questions (i.e. 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)

- Questions from the laboratory shall be included in the SEE into the appropriate modules

REFERENCE BOOKS:

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 3rd Edition, Auerbach Publications, 2008.
2. Mauro Pezze, Michal Young: Software Testing and Analysis - Process, Principles and Techniques, Wiley India, 2009.
3. Complete guide to test automation Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects Arnon Axelrod, 2018.
4. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.
5. Selenium Web driver from foundations to framework, Yujun Liang and Alex Collins, 2016

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://nptel.ac.in/courses/106/105/106105150/
2. https://onlinecourses.nptel.ac.in/noc19_cs71/preview
3. https://www.youtube.com/watch?v=OGImfx02TEU&t=10s
4. https://www.youtube.com/watch?v=Q50ZyydS7pl

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INFORMATION AND NETWORK SECURITY

(Effective from the Academic Year 2025 - 26)

VII SEMESTER

Course Code	BIS703E1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basic knowledge of Operating Systems, Computer networks, and Cryptography

COURSE OBJECTIVES:

This course will enable students to:

- Analyze the fundamentals and applications of cryptographic techniques used to secure data.
- Summarize the mechanisms used in digital security processes, including hashing, authentication, and key management.
- Explore the evolution of classical and modern cryptographic methods and protocols.
- Illustrate the cryptographic applications used in real-world domains such as the Internet, wireless networks, mobile systems, secure payment systems, and digital identity.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Classical Encryption Techniques: Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. **Block Ciphers and the Data Encryption Standard:** Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example,	**10 Hours**

results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm	
MODULE II	
Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, public key infrastructure. **User Authentication**: Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one-way Authentication, Kerberos, Motivation, Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one-way Authentication, federated identity management, identity management, identity federation, personal identity verification	**10 Hours**
MODULE III	
Wireless network security: Wireless security, Wireless network threats, Wireless network measures, mobile device security, security threats, mobile device security strategy, IEEE 802.11 Wireless LAN overview, the Wi-Fi alliance, IEEE 802 protocol architecture. Security, IEEE 802.11i services, IEEE 802.11i phases of operation, discovery phase, Authentication phase, key management phase, protected data transfer phase, the IEEE 802.11i pseudorandom function. **Web Security Considerations:** Web Security Threats, Web Traffic Security Approaches. Secure Sockets Layer: SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, and shake Protocol, Cryptographic Computations. **Transport Layer Security:** Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, and Padding. HTTPS Connection Initiation, Connection Closure. Secure Shell(SSH) Transport Layer Protocol, User Authentication Protocol, Connection Protocol	**10 Hours**
MODULE IV	
Electronic Mail Security: Pretty good privacy, notation, operational; description, S/MIME, RFC5322, Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow. **IP Security:** IP Security overview, applications of IPsec, benefits of IPsec, Routing applications, IPsec documents, IPsec services, transport and tunnel modes, IP Security policy, Security associations, Security associations database, Security policy database, IP traffic processing, Encapsulating Security payload, ESP format, encryption and authentication algorithms, Padding, Anti replay service, transport and tunnel modes, combining security associations, authentication plus confidentiality, basic combinations of security	**10 Hours**

associations, internet key exchange, key determinations protocol, header and payload formats, cryptographic suits.	

COURSE OUTCOMES

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

CO1	Explain the classical encryption techniques, design principles of block ciphers, and operation of the Data Encryption Standard (DES).	CL2
CO2	Demonstrate an understanding of key management and distribution mechanisms, and make use of various authentication techniques for secure communication.	CL3
CO3	Demonstrate an understanding of wireless network security protocols, identify web security threats, and apply principles of Transport Layer Security (TLS) to ensure secure end-to-end communication.	CL3
CO4	Illustrate the mechanisms of electronic mail security protocols and utilize the functionalities of IP Security (IPSec) to ensure confidentiality, integrity, and authentication in data transmission.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I
M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02

3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Cryptography and Network Security, William Stallings, 6th edition
2. Cryptography and Information Security, V K Pachghare, PHI, 2nd

REFERENCE WEB LINKS AND VIDEO LECTURES (E - E-RESOURCES):

1. https://nptel.ac.in/courses/106105031
2. https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-cs31/
3. https://www.coursera.org/learn/computer-security
4. https://datatracker.ietf.org/doc/html/rfc5280

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BLOCK CHAIN TECHNOLOGY

(Effective from the Academic Year 2025 - 2026)

VII SEMESTER

Course Code	BIS703E2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of data communications and networking

COURSE OBJECTIVES:

This course will enable students to:

- Understand blockchain terminologies with their applications.
- Learn the working principles of Blockchain and the methodologies used in Bitcoin.
- Gain knowledge on the Ethereum Network, Wallets, Nodes, Smart contracts & DApps.
- Learn blockchain-based application Architecture using Hyperledger and the Smart Contract Lifecycle.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE - I

Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, Various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.	**10 Hours**

MODULE - II

Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies, Decentralized applications,	**10 Hours**

Platforms for decentralization. Cryptographic primitives: Symmetric cryptography, Asymmetric cryptography, Public and private keys, Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD), Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA).	

MODULE - III

Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block, The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO.	**10 Hours**

MODULE - IV

Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network. Hyperledger, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth Lake, Corda.	**10 Hours**

COURSE OUTCOMES

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

CO1	Explain the Blockchain terminologies with its applications.	CL2
CO2	Illustrate the working principles of Blockchain and the Smart Contract Lifecycle.	CL2
CO3	Demonstrate the principles and methodologies used in Bitcoin.	CL2
CO4	Develop Ethereum Network and make use of Hyperledger in Blockchain-Based Application Architecture.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus Coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I

M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Imran Bashir. "Mastering Blockchain", Third Edition, Packt – 2020.
2. Andreas M., Mastering Bitcoin: Programming the Open Blockchain – O'rielly – 2017.
3. Arvind Narayanan, Joseph Bonneau, Edward W. Felten, Andrew Miller, Steven Goldfeder, and Jeremy Clark. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.

4. Mastering Bitcoins: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos. O'Reilly Media, Inc., 2013.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - E-RESOURCES):

1. https://nptel.ac.in/courses/106104220
2. https://www.geeksforgeeks.org/blockchain/
3. https://www.tutorialspoint.com/blockchain/index.htm
4. http://bitcoinbook.cs.princeton.edu/?_ga=2.8302578.1344744326.1642688462-86383721.1642688462
5. https://nptel.ac.in/courses/106/105/106105184/
6. https://ethereum.org/en/developers/
7. https://developer.ibm.com/components/hyperledger-fabric/tutorials/

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NATURAL LANGUAGE PROCESSING

(Effective from the Academic Year 2025 – 26)

VII SEMESTER

Course Code	BIS703E3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamentals of Automata Theory

COURSE OBJECTIVES:

This course will enable students to:

- Define natural language and analyze its importance.
- Analyze spelling error detection and correction methods and parsing techniques in NLP.
- Understand the Applications of natural language processing.
- Illustrate the information retrieval models in natural language processing.
- Explore the use of WordNet and FrameNet in the Natural Language Processing database.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Overview and language modeling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications. **Language Modeling**: Statistical Language Model- N-gram model, Paninian Framework, Karaka theory.	**10 Hours**

MODULE II

Word Level Analysis: Regular Expressions, Finite State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes-Part-of Speech Tagging. **Syntactic Analysis:** Context-free Grammar, Constituency, top-down and bottom-up Parsing, CYK parsing.	**10 Hours**

MODULE III

Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation. **Natural Language Generation:** Architecture of NLG Systems, Generation Tasks and Representations, Applications of NLG. **Lexical Resources**: World Net, Frame Net, Stemmers, POS Tagger- Research Corpora.	**10 Hours**

MODULE IV

Machine Translation: Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, Translating in low-resource situations, MT Evaluation, Bias and Ethical Issues. **Chatbots & Dialogue Systems**: Properties of Human Conversation, Frame-Based Dialogue Systems, Dialogue Acts and Dialogue State, Chatbots, Dialogue System Design	**10 Hours**

COURSE OUTCOMES

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

CO1	Understand NLP fundamentals and apply basic language modeling techniques.	CL2
CO2	Perform word-level and syntactic analysis using formal methods.	CL3
CO3	Apply semantic analysis and use lexical resources in NLG tasks.	CL3
CO4	Understand machine translation techniques and design simple dialogue systems.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks

1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling to 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice i.e. 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice i.e. 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
2. D. Jurafsky, J. H. Martin, “Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (3e)”, Pearson Education, 2023.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://youtu.be/02QWRAhGc7g
3. https://www.youtube.com/watch?v=CMrHM8a3hqw

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ROBOTIC PROCESS AUTOMATION

(Effective from the Academic Year 2025 - 2026)

VII SEMESTER

Course Code	BIS703E4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of data communications and networking

COURSE OBJECTIVES:

This course will enable students to:

- Understand basic concepts of RPA.
- Describe RPA, where it can be applied, and how it's implemented
- Describe the different types of variables, Control Flow, and data manipulation techniques
- Understand Image, Text, and Data Tables Automation
- Describe various types of Exceptions and strategies to handle

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE - I

RPA Foundations: What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM, and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR- Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall, DevOps- Flowcharts.	**10 Hours**

MODULE - II

RPA Platforms: Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- Task recorder - Step-by-step examples using the recorder.	**10 Hours**

MODULE - III

Sequence, Flowchart, and Control Flow: Sequencing the workflow Activities-Control flow, various types of loops, and decision-making Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control Flow-Data Manipulation-Variables and Scope Collections-Arguments – Purpose and use-Data table usage with examples Clipboard Management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).	**10 Hours**

MODULE - IV

Taking Control of the Controls: Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR. Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots -Future of RPA.	**10 Hours**

COURSE OUTCOMES

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

CO1	Demonstrate the fundamental concepts of RPA with its features.	CL2
CO2	Explain the various components and platforms of RPA	CL2
CO3	Describe the different types of variables, control flow, and data manipulation techniques.	CL2
CO4	Illustrate the various control techniques, OCR in RPA, and show the different exception handling strategies.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		

Syllabus Coverage			Syllabus Coverage	Syllabus Coverage
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: Apress
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing, Release Date: March 2018 ISBN:9781788470940.
3. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: A Primer”, Institute of Robotic Process Automation.
4. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
5. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.uipath.com/rpa/robotic-process-automation

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INTRODUCTION TO ALGORITHMS

(Effective from the Academic Year 2025 – 26)

VII SEMESTER

Course Code	BIS704Q1	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of Mathematics, Data Structures.

COURSE OBJECTIVES:

This course will enable students to:

- Describe the techniques for analyzing algorithms and how to evaluate their performance. Indicate the effectiveness of the method using asymptotic notations.
- Utilize algorithm design techniques, including brute force, greedy, divide-and-conquer, decrease-and-conquer, transform-and-conquer, dynamic programming, backtracking, and branch-and-bound to solve issues.
- Decide on the best data structure and algorithm design technique for the given application.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery:

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to Algorithms- Properties, Specification, Fundamentals of Algorithmic Problem solving, Analysis Framework. **Performance Analysis:** Estimating Space complexity and Time complexity of algorithms. Asymptotic Notations with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples. **Brute force design techniques:** Selection sort, sequential search and String-matching algorithm with complexity Analysis.	**10 Hours**

MODULE II	
Divide and Conquer: Divide and Conquer algorithms and complexity Analysis of finding the maximum & minimum, Merge sort, and Quick sort. **Decrease and Conquer Approach:** Introduction, Insertion sort**,** and efficiency analysis. **Greedy Method:** General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems.	**10 Hours**
MODULE III	
Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm with performance analysis. **Single-source shortest paths:** Dijkstra's Algorithm. **Optimal Tree problem:** Huffman Trees and Codes. **Transform and Conquer Approach:** Introduction, Heaps and Heap Sort. **Space-Time Tradeoffs:** Introduction, Sorting by Counting, Input Enhancement in String Matching-Harspool's algorithm.	**10 Hours**
MODULE IV	
Dynamic Programming: General Method with Examples. **Transitive Closure:** Warshall's Algorithm. **All Pairs Shortest Paths:** Floyd's Algorithm, Knapsack problem and memory functions, Travelling Salesperson problem. **Backtracking:** General method, solution using backtracking to N-Queens problem, Sum of subsets Problem and Hamiltonian cycles Problems. **Branch and Bound:** Assignment Problem, Travelling Sales Person problem, Knapsack problem	**10 Hours**

COURSE OUTCOMES

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

CO1	Solve the time complexity of recursive, non-recursive, and brute force algorithms using asymptotic notations.	CL3
CO2	Solve the recurrence relation to obtain the performance of the divide-and-conquer, decrease-and-conquer approach.	CL3
CO3	Apply graph and tree algorithms like Prim's, Kruskal's, Dijkstra's, and Huffman coding to solve problems. Use heap sort, counting sort, and Horspool's string matching for efficient computation.	CL3
CO4	Apply dynamic programming, backtracking, and branch and bound techniques to solve optimization and decision problems.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30

	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	**Assignment Description**	**Max. Weightage (%)**	**Max. Marks**
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)

d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, 2012. Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni, and Rajasekaran, 2nd Edition, 2014, Universities Press. Reference Books
3. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
4. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLyqSpQzTE6M9DKhN7z2fOpKTJWu-639_P
2. https://www.youtube.com/watch?v=5Y8Lfsreeck&list=PL7DC83C6B3312DF1E
3. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_VZKxRKrxgFyOutPJpoLFBaQMOpK-

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FUNDAMENTALS OF OPERATING SYSTEM

(Effective from the Academic Year 2025 - 2026)

VII SEMESTER

Course Code	BIS704Q2	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	**40L**	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of Data Structures, Algorithms

COURSE OBJECTIVES:

- Explain the fundamentals of an operating system
- Comprehend multithreaded programming, process management, memory management, and storage management.
- Familiar with various types of operating systems

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE - I

Introduction: What OS do, Computer system organization, architecture, structure, Operations, Process, memory and storage management, Protection and security, Distributed systems, Special purpose systems, computing environments. **System Structure:** OS Services, User OSI, System calls, Types of system calls, System programs, OS design and implementation, OS structure, Virtual machines, OS generation, System boot.	**10 Hours**

MODULE - II

Process Concept: Overview, Process scheduling, Operations on process, IPC, Examples in IPC, Communication in client-server systems. **Multithreaded Programming**: Overview, Models, Libraries. **Process Scheduling**: Basic concept, Scheduling criteria, Algorithm, multiple processor scheduling, thread	**10 Hours**

scheduling.	
MODULE - III	
Synchronization: Background, the critical section problem, Petersons solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors, Synchronization examples. **Deadlocks**: System model, Deadlock characterization, Method of handling deadlock, Deadlock prevention, Avoidance, Detection, Recovery from deadlock.	**10 Hours**
MODULE - IV	
Memory management strategies: Background, swapping, contiguous memory allocation, paging, structure of page table, and swapping. **Virtual Memory management**: Background, Demand paging, Copy-on-write, Page replacement, Allocation of frames. **Mass Storage Structure:** Overview of Mass storage structure, HDD scheduling. **File system**: File concept, Access methods, Directory structure, File system mounting, File sharing, protection, Allocation methods, Free space management.	**10 Hours**

COURSE OUTCOMES

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

CO1	Illustrate the Operating System, its components, and the idea behind the system calls and Inter-Process communications.	CL2
CO2	Use the concepts of multithreading and demonstrate various algorithms by considering different scheduling criteria.	CL3
CO3	Illustrate the process synchronization, its classical approaches, and solve the deadlock problem.	CL3
CO4	Explain the concepts of memory management and solve the various page replacement problems.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	30 %	15
	Assignment	20%	10
	Laboratory Continuous Assessment	30%	15
	Laboratory Test	20%	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)					Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (30%)			Assignment (20%)	Practical (50%)	
I	II	III			
Syllabus Coverage			Syllabus Coverage		Syllabus Coverage
35%	35%	30%	100%	100%	100%
M I (Full)			M I	M I	M I

M II (50%)	M II (50%)		M II	M II	M II
	M III (60%)	M III (40%)	M III	M III	M III
		M IV (Full)	M IV	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii)
- Questions from the laboratory shall be included in the SEE in the appropriate modules

REFERENCE BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Principles", 10th edition, Wiley-India, 2021
2. M. Morris Mano, "Computer System Architecture", PHI, 3rd Edition
3. Ann McHoes, Ida M Fylnn, "Understanding Operating Systems", Cengage Learning, 6th Edition
4. D.M. Dhamdhere, "Operating Systems: A Concept-Based Approach", 3rd Edition, McGraw-Hill, 2013.

5. P.C.P. Bhatt, “An Introduction to Operating Systems: Concepts and Practice”, 4th Edition, PHI(EEE), 2014.
6. William Stallings, “Operating Systems: Internals and Design Principles”, 6th Edition, Pearson.

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.geeksforgeeks.org/operating-systems/
2. https://www.youtube.com/watch?v=RozoeWzT7IM&list=PLdo5W4Nhv31a5ucW_S1K3-x6ztBRD-PNa
3. https://en.wikipedia.org/wiki/Operating_system
4. https://www.youtube.com/watch?v=By6lWjiPpVI&list=PLG9aCp4uE-s17rFjWM8KchGlffXgOzzVP
5. https://www.youtube.com/watch?v=bkSWJJZNgf8&list=PLxCzCOWd7aiGz9donHRrE9I3Mwn6XdP8

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INTRODUCTION TO CLOUD COMPUTING

(Effective from the Academic Year 2025 – 26)

VII SEMESTER

Course Code	BIS704Q3	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:4	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of databases, Operating Systems, and Networking

COURSE OBJECTIVES:

This course will enable students to:

- Understand the fundamental concepts and architecture of cloud computing, including deployment models and service models.
- Develop skills to implement, manage, and optimize cloud-based solutions for diverse applications.
- Analyze security, privacy, and compliance issues related to cloud computing environments.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction: The Evolution of Cloud Computing; What Is Cloud Computing? Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model, Cloud Deployment Models, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise. Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing	**10 Hours**

MODULE II

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware	**10 Hours**

support for virtualization, Case Study: Xen a VMM based paravirtualization.	

MODULE III

Identity and Access Management: Trust Boundaries and IAM, Why IAM? IAM Challenges, IAM Definitions, IAM Architecture and Practice, Relevant IAM Standards and Protocols for Cloud Services, IAM Standards, Protocols, and Specifications for Consumers, Comparison of Enterprise and Consumer Authentication Standards and Protocols, IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice.	**10 Hours**

MODULE IV

Security Management in the Cloud: Introduction, Security Management Standards, Security Management in the Cloud, Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control, Security Vulnerability, Patch, and Configuration Management. **Amazon web services:** EC2 instances, connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in Java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud-based optimal FPGA synthesis	**10 Hours**

COURSE OUTCOMES

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

CO1	Outline the concept of cloud computing and discuss the types of services offered through cloud computing.	CL2
CO2	Describe the IT infrastructure security capabilities offered by the cloud services. Also, identify the current state of data security and data storage in the cloud.	CL2
CO3	Explain the identity and access management (IAM) practice and make use of capabilities for Authentication, authorization, and auditing of users who access cloud services.	CL2
CO4	Explain basic cloud security concepts, availability, and access control mechanisms, and describe the use of AWS services such as EC2 and S3.	CL2

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus coverage			**Syllabus Coverage**	**Syllabus Coverage**
35%	**35%**	**30%**	**100%**	**100%**

M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif: "Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance", O'Reilly Media, 2009.
2. Cloud Computing: Theory and Practice, Dan C Marinescu, Elsevier (MK), 2013.
3. Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Willey, 2014.

4. Cloud Computing Implementation, Management and Security John W Rittinghouse, James 1F Ransome, CRC Press, 2013
5. Vic (J.R.) Winkler: ”Securing the Cloud, Cloud Computer Security Techniques and Tactics”, Syngress, 2011

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.digimat.in/nptel/courses/video/106105167/L01.html
2. https://www.youtube.com/watch?v=44IBhZwa4ZM
3. https://www.digimat.in/nptel/courses/video/106104182/L01.html

SAHYADRI
COLLEGE OF ENGINEERING & MANAGEMENT
An Autonomous Institution
MANGALURU

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(Effective from the Academic Year 2025 – 26)

VII SEMESTER

Course Code	BIS704Q4	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Fundamental knowledge of Mathematics concepts like probability and statistics.
- Basic knowledge of data science.

COURSE OBJECTIVES:

This course will enable students to:

- Gain a historical perspective of AI and its foundations.
- Understand the basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- Describe Artificial Intelligence and Machine Learning algorithms and evaluate their performance.
- Understand a range of machine learning algorithms along with their strengths and weaknesses.
- Illustrate AI and ML algorithm and their use in appropriate applications.
- Describe the applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.
- Apply the classification, clustering, and regression-based machine learning algorithms to solve real-time problems.
- Apply the algorithms to a real-world problem, optimize the models learned, and report on the expected accuracy that can be achieved by applying the models.

TEACHING - LEARNING STRATEGY:

The following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE I

Introduction to AI: Intelligent systems, Foundations and Sub area of AI, Applications, Tic-Tac-Toe Game playing, Currents trend and developments of AI. **Problem Solving:** General problem solving, Characteristics of problem, Heuristic search techniques, Generate and Test, Hill Climbing, Best First Search, A* Algorithm, Constraint satisfaction.	**10 Hours**
MODULE II	
Introduction: Machine Learning, Types of Machine Learning, Main challenges of Machine Learning, Testing and Validating, Performance measures, Concept Learning tasks, Concept Learning as search, Find S algorithm, Version Spaces and Candidate Elimination algorithm. **Decision Tree Learning:** Introduction, Decision tree representation, Appropriate problems, ID3 algorithm.	**10 Hours**
MODULE III	
Artificial Neural Network: Introduction, NN representation, Appropriate problems, Perceptron, Back propagation algorithm. **Bayesian Learning:** Introduction, Bayes theorem, Bayes theorem and concept learning, Minimum description length principle, Naive Bayes Classifier, Text Classification, Bayesian Belief Network (BBN).	**10 Hours**
MODULE IV	
Unsupervised Learning Techniques: Clustering algorithms: K-Means. **Instance-Base Learning**: Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Linear SVM classification, Nonlinear SVM classification, SVM Regression. **Reinforcement Learning**: Introduction, The learning task, Q-Learning.	**10 Hours**

COURSE OUTCOMES

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

CO1	Apply foundational concepts of Artificial Intelligence (AI) to design intelligent systems and explain problem-solving strategies using heuristic search techniques such as A* Algorithm and Hill Climbing.	CL3
CO2	Implement machine learning techniques such as Find-S and Candidate Elimination algorithms to solve concept learning tasks and decision tree-based models using the ID3 algorithm.	CL3
CO3	Apply artificial neural network techniques and implement Bayesian learning approaches, such as Naive Bayes Classifier and Bayesian Belief Networks, for probabilistic reasoning.	CL3
CO4	Illustrate unsupervised learning techniques like K-Means clustering, and apply reinforcement learning approaches like Q-Learning to solve real-world problems.	CL3

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students' learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20

2	Semester End Examination (SEE)	100 %	50

CO - ASSESSMENT MAPPING

Continuous Internal Assessment (CIA) (50%)				Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (60%)			Assignment/ Activities (40%)	
I	II	III		
Syllabus coverage			Syllabus Coverage	Syllabus Coverage
35%	35%	30%	100%	100%
M I (Full)			M I	M I
M II (50%)	M II (50%)		M II	M II
	M III (60%)	M III (40%)	M III	M III
		M IV (Full)	M IV	M IV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with a higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity-Based Learning	50 %	10
7	Project-Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have **TWO** parts, viz. **Part A (20 Marks)** and **Part B (80 Marks)**
- In Part A, Question 1 shall be mandatory and can have any number of sub-questions, each of 01-03 marks, totaling 20, covering all four modules.
- In Part B, a student has to answer 4 FULL questions, where,
  a. Question no. 2 shall be set from Module I for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  b. Question no. 3 shall be set from Module II for a maximum of 20 marks and will be mandatory. The question may contain a maximum of three sub-questions
  c. Question no. 4 shall be set from Module III for a maximum of 20 marks and shall contain a choice, i.e., 4A or 4B. Each question may contain a maximum of three sub-questions (i.e., 4Ai, 4Aii, 4Aiii (OR) 4Bi, 4Bii, 4Biii)
  d. Question no. 5 shall be set from Module IV for a maximum of 20 marks and shall contain a choice, i.e., 5A or 5B. Each question may contain a maximum of three sub-questions (i.e., 5Ai, 5Aii, 5Aiii (OR) 5Bi, 5Bii, 5Biii).

REFERENCE BOOKS:

1. Saroj Kaushik, Artificial Intelligence, 2011 Cengage Learning India Pvt. Ltd, 1St Edition, ISBN: 978-81-315-1099-9.
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &TensorFlow, O'Reilly Media Publications, 3rd Edition, 2022, ISBN: 978-93-5542-198-2.
3. Tom M Mitchell, Machine Learning, McGraw-Hill Education Pvt. Ltd, 1st Edition, 2017, ISBN: 978-1-25-909695-2.
4. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd., 3rd Edition, 2014, ISBN: 978- 81-203-5078-6.
5. Elaine Rich, Kevin Kand S B Nair, "Artificial Intelligence", 3rd Edition, McGraw-Hill Education, 2017

REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
2. https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
3. https://nptel.ac.in/courses/106/105/106105077/
4. https://www.javatpoint.com/history-of-artificial-intelligence
5. https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence
6. https://techvidvan.com/tutorials/ai-heuristic-search/
7. https://www.analyticsvidhya.com/machine-learning/
8. https://www.javatpoint.com/decision-tree-induction
9. https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/mldecision-tree/tutorial/
10. https://www.javatpoint.com/unsupervised-artificial-neural-networks

SAHYADRI
COLLEGE OF ENGINEERING & MANAGEMENT
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MANGALURU

SOFTWARE TESTING LABORATORY

(Effective from the Academic Year 2025 - 2026)

VII SEMESTER

Course Code	BIS705L	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	20P	Exam Hours	03

CREDITS – 1

COURSE PREREQUISITES:

- Basic Knowledge of Software Engineering and C or JAVA.

COURSE OBJECTIVES:

This course will enable students to:

- Analyse the requirements for the given problem statement
- Design and implement various solutions for the given problem
- Employ various design strategies for problem solving.
- Construct control flow graphs for the solution that is implemented
- Create appropriate document for the software artefact.

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Exp. No.	Experiment Description	Bloom's Taxonomy Level
1.	Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis, execute the test cases and discuss the results.	CL4

2.	Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.	CL4
3.	Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.	CL4
4.	Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on equivalence class partitioning, execute the test cases and discuss the results.	CL4
5.	Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of equivalence class testing, derive different test cases, execute these test cases and discuss the test results.	CL4
6.	Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of equivalence class value testing, derive different test cases, execute these test cases and discuss the test results.	CL4
7.	Write and test a program to count number of check boxes on the page checked and unchecked count using SELENIUM IDE.	CL4
8.	Write and test a program to provide total number of objects present available on the page SELENIUM IDE.	CL4
9.	Write and test a program to update 10 student records into table into Excel file.	CL4
10.	Write and test a program to provide total number of objects present/ available on the page.	CL4
11.	Write and test a program to get the number of list items in a list /combo box.	CL4
12.	Write and test a program to count number of check boxes on the page checked and unchecked count using SELENIUM IDE.	CL4

COURSE OUTCOMES

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

CO No.	**Course Outcome Description**	**Bloom's Taxonomy Level**
CO1	Design and develop test cases based on Boundary value Analysis and equivalence class partitioning testing method.	CL4
CO2	Design and develop test cases using Decision table approach and analyze the test cases along with the results.	CL4
CO3	Analyze structural testing techniques using Data flow approach.	CL4
CO4	Design and develop test cases using SELENIUM IDE and analyze the test cases along with the results.	CL4

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In the Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
- A Laboratory Test, similar to the SEE exam, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.
- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.

In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

1. All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot
2. SEE shall be conducted for 100 Marks, and the marks will be scaled down to 50
3. General marks distribution: Procedure + Conduction + Viva = 20% + 50% + 30%. However, the BoE may change the same according to the course requirements

4. Change of experiment is allowed only once, and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.
5. The request for the change of experiment shall be submitted by the student within half an hour from the commencement of the examination. The change of experiment shall be allowed only once in a particular examination.

SUGGESTED LEARNING RESOURCES:

BOOKS:

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 3rd Edition, Auerbach Publications, 2008.
2. Mauro Pezze, Michal Young: Software Testing and Analysis - Process, Principles and Techniques, Wiley India, 2009.
3. Complete guide to test automation Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects Arnon Axelrod, 2018.
4. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.
5. Selenium Web driver from foundations to framework, Yujun Liang and Alex Collins, 2016

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://nptel.ac.in/courses/106/105/106105150/
2. https://onlinecourses.nptel.ac.in/noc19_cs71/preview
3. https://www.youtube.com/watch?v=OGImfx02TEU&t=10s
4. https://www.youtube.com/watch?v=Q50ZyydS7pl