Department of Computer Science and Engineering
III Semester
Scheme of Teaching 2024 – 28 Batch

Sl. No.	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Hours Per Week	Credits	Examination		
					Lecture	Tutorial	Practical	Project					
					L	T	P	J			CIA	SEA	Total
1	BSC	24MAC131	Fourier Transforms, Fundamentals of Logic and Linear Algebra	Mathematics	2	2	-	-	4	3	50	50	100
2	PCC	24CSE132	Logic Design and Computer Organization	CSE	2	2	-	-	4	3	50	50	100
3	PCC	24CSE133	Operating System	CSE	2	-	2	-	4	3	50	50	100
4	PCI-P	24CSE134	Data Structures and Applications Using C	CSE	3	-	2	-	5	4	50	50	100
5	PCI-P	24CSE135	Data Analysis	CSE	2	-	2	-	4	3	50	50	100
6	PCI-P	24CSE136	Object Oriented Programming using Java	CSE	2	-	2	-	4	3	50	50	100
7	PBL	24CSE137	Innovative Project Learning (Social Concern)	CSE	-	-	-	2	2	1	100	-	100
8	AEC	24SFT138	Soft Skills – I	HSS	-	-	2	-	2	1	100	-	100
Total					13	4	10	2	29	21	500	300	800

CIE: Continuous Internal Evaluation, SEE: Semester End Examination, NCMC: Non Credit Mandatory Course AICTE Activity Points to be earned by students admitted to BE day college programme (Fo more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme Students transferred from other institutions and Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to BNMIT. The Activity Points earned shall be reflected or the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the yea of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. I case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

BSC → Basic Science	PW → Project Work	MAT → Mathematics	PEC → Professional Elective	INT → Internship
PBL → Project Based Learning	OEC → Open Elective	HUM → Humanities and Social Science	PCC → Professional Core Course	PCI → Professional Core Course Integrated
AEC → Ability Enhancement Course	UHV → Universal Human Values			

Head of the Department
Dept. of Computer Science & Engineering
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Additional Director & Principal
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B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: III			
Course: Fourier Transform, Mathematical logic and Advanced Linear Algebra			
Course Code: 24MAC131 (Common to CSE, ISE, AIML)			
L:T:P:J	**2:2:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1 Have an insight into Fourier series, Fourier transforms.

2 Develop knowledge of Fundamentals of logic and Relations, Vector Spaces, Linear Transformation & Inner product spaces arising in engineering

Module-1: Fourier Series & Fourier Transforms	No. of hours	Blooms cognitive Levels
Examples from Engineering that require Fourier series and Fourier Transforms. **Fourier series**: Periodic functions, Introduction to Fourier Series, Dirichlet's condition. Problems on Fourier series over $(-l, l)$. **Fourier Transforms:** Introduction to infinite Fourier transform, Fourier sine and cosine transform and properties, problems on infinite Fourier transform, Discrete & Fast Fourier transform. *Experiential Learning component: Finding the Fourier series and Fourier Transform of a function*	**L : 04** **T : 04**	**L1** **L2** **L3**
Module-2: Mathematical logic and Boolean Algebra		
Examples from Engineering that require Fundamentals of logic and Relations. **Mathematical logic:** Basic connectives and truth tables, logic equivalence - the laws of logic, logical implication- rules of inference **Boolean Algebra:** Boolean functions, Representation of Boolean functions, Logic gates, minimization of circuits. *Experiential Learning component: Construction of combinational and sequential circuit.*	**L : 04** **T : 04**	**L1** **L2** **L3**
Module-3: Vector Spaces		
Examples from Engineering that require vector spaces Recap of system of linear homogenous and non-homogeneous equation and solution sets. Vector spaces, subspaces, linearly independent and dependent, Linear span of a set, Basis and dimension, coordinate vectors. *Experiential Learning component: Problems on linearly independent and dependent vectors, basis and dimension of a vector space.*	**L : 04** **T : 04**	**L1** **L2** **L3**
Module-4:Linear Transformation		
Examples from Engineering that require linear transformation. Linear transformations, algebra of linear transformations, representation of transformations by matrices, Non-singular linear transformation, Inverse of a linear transformation, Range space, Null space and problems on Rank-nullity theorem. *Experiential Learning component: Problems on Inverse of a linear transformation and Rank-nullity theorem*	**L : 04** **T : 04**	**L1** **L2** **L3**
Module-5: Inner Product Spaces		
Examples from Engineering that require Inner product spaces. Inner products Inner product spaces, Orthogonal set, orthogonal projections, orthonormal bases, Gram-Schmidt process, QR-factorization, Recap of Eigen values and Eigen vectors, problems on Singular value decomposition. *Experiential Learning component: Problems on QR-factorization and singular value decomposition*	**L : 04** **T : 04**	**L1** **L2** **L3**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Apply Fourier series & transform concepts in data visualization and cryptography.
CO 2:	Convert Boolean expressions to logic gates and vice-versa.
CO 3:	Apply the knowledge of vector spaces for solving problems in arising in engineering field
CO 4:	Apply the knowledge of linear transform for solving problems in arising in image processing
CO 5:	Compute orthogonal and orthonormal bases vectors and decomposition of a symmetric matrix using standard technique.

CO - PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2			2							
CO 2	3	2			2							
CO 3	3	2			2							
CO 4	3	2			2							
CO 5	3	2			2							

Reference Books:

1. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons,10th Edition(Reprint), 2016.
2. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2017.
3. C. Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6" Edition, 2. McGraw-Hill Book Co., New York, 1995.
4. James Stewart : "Calculus —Early Transcendentals", Cengage Learning India Private Ltd., 2017.
5. Srimanta Pal & Subodh C Bhunia: "Engineering Mathematics", Oxford University Press, 3"Reprint, 2016.
6. David C. Lay, Steven R. Lay and J. J. McDonald "Linear Algebra and its applications", 3rd Edition, Pearson Education Ltd., 2017.
7. Kenneth H Rosen, "Discrete Mathematics and its Applications, Special Indian Edition 2021, McGraw Hill publication (India).
8. Ralph P. Grimaldi, " Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education 2004.

Web links and Video Lectures:

1. https://nptel.ac.in/courses/111106111
2. https://youtu.be/OynpZwylau8
3. https://archive.nptel.ac.in/courses/111/106/111106051/
4. https://www.youtube.com/watch?v=zvRdbPMEMUI
5. https://www.youtube.com/watch?v=PiG2BMkK3s4
6. https://www.youtube.com/watch?v=ATqV_I8DCh0

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III		
Course Name: Logic Design and Computer Organization		**Course Code: 24CSE132**
L: T: P: J	2:2:0:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4 (40)	**SEA Duration:** 03 Hours

Pre-Requisites: Basic Electronics

Course Learning Objectives: The students will be able to

1	Understand the basic digital principles and working of various logic gates, and different techniques for simplification of Boolean function.
2	Design combinational logic circuits and describe their applications
3	Design and Analyze working of sequential circuits and its applications
4	Describe different types of processor technology and Memory Hierarchy in CISC, RISC and VLIW architecture.

Module1: Combinational Logic Circuits	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Digital Principles: Definition of Digital Signals, Digital Waveforms, Digital Logic. **Digital Logic:** The Basic Gates-: NOT, OR, AND, Universal Logic Gates: NOR, NAND, Positive and Negative Logic **Combinational Logic Circuits:** Sum-of-Products & Product-of-Sum Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Simplification by Quine-McCuskey Method, HDL Implementation Models **Text Book 1: Chapter 1,2, & 3 (Specified Topics Only)**	**8**	**Apply CO1**
Module2: Data-Processing Circuits		
Data-Processing Circuits: Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD-to-decimal Decoders, Encoders, Exclusive-or Gates, Parity Generators and Checkers, Magnitude Comparator, Programmable Array Logic, Programmable Logic Arrays, HDL Implementation of Data Processing Circuits	**8**	**Apply CO2**
Module-3: Sequential Circuits		

Flip-Flops: Definition, Clocked RS Flip-Flops, Clocked D Flip-Flops, Edge-Triggered RS Flip-Flops, Edge-Triggered D- Flip-Flops, Edge-Triggered JK Flip-Flops JK Master-Slave. Flip-Flops, Various Representations of Flip-Flops, HDL Implementation of Flip-Flops **Registers:** Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out, Universal Shift Register, Register Implementation in HDL **Counters:** Definitions: Counter, Asynchronous Counter, Synchronous Counter, Counter Design as A Synthesis Problem, A Digital Clock, Counter Design using HDL **Text Book 1:** Chapter 8,9 & 10 (Specified Topics Only)	**8**	**Apply CO3**
Module4: Basic Structure of Computers		
Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions **Text book 2:** Chapter1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter2 – 2.2 to 2.10	**8**	**Understand CO4**
Module-5: Processors and Memory Hierarchy		
Processors and Memory Hierarchy. Advanced Processor Technology. Design Space of Processors, Instruction-Set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar and Vector Processors, Superscalar Processors, The VLIW Architecture, Vector and Symbolic Processors, Memory Hierarchy Technology, Hierarchical Memory Technology Inclusion, Coherence, and Locality, Memory Capacity Planning**.** **Chapter 4 from text book 03 (4.1 to 4.3)**	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE132.1	Illustrate with Various logic gates and Problem-Solving Techniques.
24CSE132.2	Experiment with various data processing circuits.
24CSE132.3	Make use of basic concepts and implement with various Sequential Circuits.
24CSE132.4	Demonstrate the machine instructions and addressing modes, interrupts and DMA
24CSE132.5	Identify different types of processor technology and Memory Hierarchy in CISC, RISC and VLIW architecture.

Text Books

1. Digital Principles and Applications, Seventh Edition (Indian Special Edition) by Donald P Leach, Albert Paul Malvino and Goutam Saha, Tata McGraw Hill, 2011
2. Computer Organization- Carl Hamacher, ZvonkoVranesic, SafwatZaky:, 5th Edition, Tata McGraw Hill,2018
3. Advance Computer Architecture: Parallelism, Scalability, Programmability, 3 Edition, McGraw Hill Education.

Reference Books

1. R D Sudhakar Samuel, K.S. Nandini Prasad: Logic Design, 1st edition, Elsevier Publication, 2013.
2. M Morris Mano: Digital Logic and Computer Design, 14th Impression, Pearson, 2012. ISBN 978-81-7758-409-7.
3. Charles H. Roth: Fundamentals of Logic Design, Jr., 5th Edition, Thomson, 2004
4. Computer Organization & Architecture - William Stallings, 10th Edition, Pearson, 2016.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Activity to demonstrate all the phases of the software development life cycle (Poster Presentation)	10
	AAT	Conduct quiz after 1st IA /Assignments	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

Course Name: Operating System		**Course Code: 24CSE133**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4 (40)	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Introduce concepts and terminology used in OS
2	Explain threading and multithreaded systems
3	Illustrate process synchronization and concept of Deadlock
4	Introduce to Unix File Systems

Module-1: Introduction to Operating System& Process Management	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Fundamental Concepts of Operating System: Introduction to Operating systems, Operating system functions and services, System boot. **Process Management:** Process abstraction, process address space, process management, system calls, threads. **CPU Scheduling:** Levels of scheduling, comparative study of scheduling algorithms, Multilevel Queue Scheduling, Multi- processor scheduling.	**8**	**Applying CO1**
Module-2: Process Synchronization and Deadlocks		
Concurrent Processes: Critical section problem, Semaphores, Classical problems of synchronization, monitors, inter-process communication, message passing mechanisms. **Deadlocks:** Characterization, prevention and avoidance, deadlock detection and recovery.	**8**	**Applying CO2**
Module-3: Memory Management		
Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation, Demand paging, page replacement algorithms, thrashing, Disk Scheduling.	**8**	**Applying CO3**
Module-4: Unix files System		
Unix files: UNIX Architecture, Naming files, Basic file types/categories, Organization of files, Hidden files, Standard directories. Parent child relationship. The home directory and the HOME variable. Reaching required files- the PATH variable, manipulating the PATH, Relative and absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative pathnames. File related commands – cat, mv, rm, cp, wc and od commands. **Practical component**: Execution of UNIX Shell Commands.	**8**	**Applying CO4**
Module-5: File attributes and permissions		
File attributes and permissions: The ls command with options. Changing file permissions: the relative and absolute permissions changing methods. Recursively changing file permissions. Directory permissions. The shells interpretive cycle: Wild cards. Removing the special meanings of wild cards. Three standard files and redirection. **Connecting commands:** Pipe, grep, egrep.	**8**	**Applying CO5**

Shell programming: Ordinary and environment variables. Read and read-only commands. Command line arguments. exit and exit status of a command. Logical operators for conditional execution. The test command and its shortcut. The if, while, for and case control statements. The set and shift commands and handling positional parameters. Simple shell program examples. **Practical component:** Execution of Wildcards & UNIX Shell Programs.		

Course Outcomes: After completing the course, the students will be able to	
24CSE133.1	Apply the concepts of process scheduling to improve CPU utilization and identify various multi- threading models
24CSE133.2	Identify the need of policies, protection required in managing deadlock, main and virtual memory & various techniques in managing concurrent processes
24CSE133.3	Apply the concept of paging & segmentation for effective memory management
24CSE133.4	Apply the concepts of Unix system and file commands to perform various tasks in files and system.
24CSE133.5	Apply the concepts of Wildcards and Shell Programming to write basic shell scripts and formulating regular expressions for Pattern matching

Text Books
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006 2. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill.
Reference Books
1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 9th Edition 2018. 2. W. Richard Stevens: Advanced Programming in the UNIX Environment, 2nd Edition, Pearson Education, 2005 3. Unix System Programming Using C++ - Terrence Chan, PHI, 1999.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
50	Written Test	• Total Number of Test: 3 • Each Theory test will be conducted for 30 marks • Average of 3 tests = 30 Marks	30
	Assignment	Assignments on Shell scripts & UNIX Commands	10
	AAT	Case study & Implementation of Algorithms in Operating Systems	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

Course Name: Data Structures & Applications		**Course Code: 24CSE134**
L: T: P: J	3:0:2:0	**CIA Marks:** 50
Credits:	4	**SEA Marks:** 50
Hours/Week (Total)	50	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Learn the fundamental data structures and identify data structuring strategies that are appropriate for a given contextual problem.
2	Illustrate and implement basic data structures such as stack, queue and linked list and apply them for the given problem.
3	Understand and distinguish the conceptual and applicative differences in trees, binary trees and binary search trees. Apply the concepts of trees for the given application.
4	Create and use appropriate data structures in C programs for solving real life problems.

Module-1: Introduction.	No. of Hours	**Blooms Cognitive Levels with CO mapping**
Review of pointers and dynamic Memory Allocation **Structures:** Types of Structures, Unions, Array of Structures, Array of Pointers. Representation of Polynomials, Representation of sparce matrix in triplet form. **Data Structures:** Classifications (Primitive & Non-Primitive), Data structure Operations. **STACKS:** Stacks, Stacks Using Dynamic Arrays, Applications of Stacks – Infix to Postfix Conversion and Postfix Expression Evaluation **Sample Programs:** Implement various types of structures. Develop a menu driven Program in C for the following operations on STACK of Integers a. Push an Element on to Stack. b. Pop an Element from Stack. c. Display the contents of Stack. d. Exit Support the program with appropriate functions for each operation. Convert given infix expression into postfix. Evaluate the given valid single digit operand postfix Expression and display the result.	10	**Understand CO1**
Module-2: Queues & Linked Lists 1		
QUEUES: Queues, Using Dynamic Arrays, Circular Queues, Priority Queues, Double ended Queues. **Linked Lists:** Singly Linked Lists (SLL), Operations on SLL. Primitive Operations: Insertion and deletion of node at both ends, Display the Linked list, searching for a given node. Representation of polynomials using linked lists. **Sample Programs:** Implement normal Queue data structure. Implement circular Queue data structure. Implement Priority Queue data structure. Create an SLL of N nodes by using Insert_at_end and perform the search operation of the node given by the user. Consider integer values. Develop a menu driven Program in C for the following operations on Singly Linked List	10	**Apply CO2**

(SLL) of Student Data with the fields: USN, Name, Branch, Sem. a. Create an SLL of N Students Data by using front insertion. b. Display the contents of SLL and count the number of nodes in it. c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL e. Exit		
Module-3: Linked Lists 2		
Doubly Linked lists (DLL): Operations on DLL. Basic Operations: Insertion and deletion of node at both the ends, Display the Linked list, searching for a given node. **Circular Linked List:** Circular SLL and Circular DLL Implementation and primitive insert and delete Operations. **Additional operations on Linked Lists:** Insertion and deletion of nodes at any given position, Searching and deletion of nodes with given value, count nodes, concatenate 2 SLL, display mid element in the list, finding sum and average of list with nodes having integer values, Representation of Sparce Matrix using linked lists. **Sample Programs:** Develop and implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Sal, a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it. c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Exit Implement circular SLL of integer nodes with insert_front and delete_at_end operations. Develop and implement a menu driven Program in C for the following operations on circular Doubly Linked List (CDLL) of Employee Data with the fields: SSN, Name, Dept, Sal, eate a DLL of N Employees Data by using end insertion. splay the status of DLL and count the number of nodes in it. rform Insertion at End of DLL rform Deletion at Front of DLL it. Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of having integer values in nodes: Create an SLL of N nodes Data by using front insertion. Search for a given node. Insert a node at given valid position (other than front and rear end) Delete node at given valid position. Exit	10	**Apply CO3**
Module-4: Trees		
Introduction to Trees: Tree terminologies, Tree classifications, General Tree Representation using DLL nodes. **Binary Trees**: Recursive Tree Traversals: Preorder, Inorder, Postorder, **Binary Search Tree**: Creation of BST, insert node into BST, Search BST, examples on Building and Evaluating Binary Expression Trees, **Threaded Binary Trees:** types, representations, and advantages. **Sample Programs:** Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 5, 2. Traverse the BST in Inorder, Preorder and Postorder. Exit. Implement a menu driven Program in C for the following operations on Binary Search	**10**	**Apply CO4**

Tree (BST) of Integers. Search the BST for a given element (KEY) and report the appropriate message. Find the Maximum and minimum values in BST. Exit		
Module-5: Heaps, Hashing & Graphs		
Heap: Definition and properties, Implementation of min or max heaps **Hashing:** Hash Table, Hash Functions, Collision Handling by Open Addressing, Chaining. **Graphs:** Disjoint sets**,** Representation of Graphs - Adjacency/ Cost Matrix, Adjacency Lists. Traversal methods: Breadth First Search / Depth First Search. **Sample Programs:** Design, Develop and Implement a code to generate a max or min heap tree. Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing. Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities Create a Graph of N cities using Adjacency Matrix. Print all the nodes reachable from a given starting node in a digraph using BFS method. Print all the nodes reachable from a given starting node in a digraph using DFS method.	**10**	**Apply CO5**

CO No.	Statement	Bloom's Cognitive Levels
24CSE134.1	To explain fundamentals of data structures and their applications.	Understanding
24CSE134.2	To illustrate representation of Different data structures such as Queues, Linked Lists.	Applying
24CSE134.3	Applying Solutions to problems using Linear Data Structures	Applying
24CSE134.4	Apply and discuss applications of Nonlinear Data Structures in problem solving.	Applying
24CSE134.5	To illustrate various applications of heaps, graphs, hash functions and concepts of collision and its resolution methods.	Applying

Text Books

1. "Horowitz, Sahni, Anderson-Freed: Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2007
2. Data Structures using C and C++, Yedidyah Langsam Moshe J. Augenstein and Aaron M. Tenenbaum, 2nd Edition, Pearson, 2009

Reference Books

1. A.M Padma Reddy," Approach of Data Structures", 5th Edition Person Publication, 2015
2. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C
3. Data Structures Using C, Reema Thareja, 1st Edition, 2011, Oxford Higher Education, ISBN-13: 978-0198099307.

Marks Distribution for Assessment:

CIA	Component	Description	Marks
50	IA Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 30 Marks. ● Average of 2 tests = 30 Marks	30
	Practical	Weekly Assessment	20
Total Marks			**50**
SEA	**Component**	**Description**	**Marks**
50	Theory Exam	5 Questions to answer of 20 Marks (6M * 5= 30M) 2 Questions from each module with internal choice. Student should answer one full question from each module.	**30**
	Execution Part	Writeup – 20 Marks Conduction – 40 Marks Viva Voce – 10 Marks	**70**
		Total marks for the Course	**100**

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

Course Name: Data Analysis		**Course Code: 24CSE135**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Develop foundational knowledge of EDA principles and techniques.
2	Gain proficiency in data manipulation, cleaning, and transformation using libraries.
3	Master the art of data visualization to effectively communicate insights.
4	Apply statistical measures and data grouping methods for analyzing data characteristics.
5	Become familiar with time series data analysis concepts.

Module-1: Introduction to EDA	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Exploratory Data Analysis Fundamentals: Understanding data science, The significance of EDA - Steps in EDA, Making sense of data: Numerical data - Discrete and continuous data,Categorical data, Measurement scales - nominal, ordinal, interval ratio, Comparing EDA with classical and Bayesian analysis, Getting started with EDA - Numpy, Pandas, Interval, Ratio,. Case Study: EDA with Personal Email: Loading the dataset, Data Transformation - Data cleaning, Loading the csv file, Converting the date, removing NaN values, Removing NaN values, Applying descriptive statistics, Data refactoring, Dropping columns, Refactoring time zones. Data Analysis - Number of emails, Time of day, Average emails per day and hour, Number of emails per day, Most frequently used words. **Practical Component:** Analyze email data for insights like number of emails, time distribution, and frequent words. Specified Topics from Chapter 1	**8**	**CO1 Apply**
Module-2: Data Transformation		
Merging database - style dataframes: Concatenating along with an axis, using df.merge with an inner join, using the pd.merge() method with a left join, using the pd.merge() method with a right join, using pd.merge() methods with outer join, Merging on index, Reshaping and pivoting. Transformation techniques: Performing data deduplication, Replacing values, Handling missing data - NaN values in pandas objects, Dropping missing values, Dropping by rows, Dropping by columns, Mathematical operations with NaN, Filling missing values, Backward and forward filling, Interpolating missing values, Renaming axis indexes, Discretization and binning, outlier detection and filtering, Permutation and random sampling - random sampling without and with replacement, Computing indicators/dummy variables, String manipulations. **Practical Component:** Download the Titanic passenger list dataset from Kaggle. a. Use pandas functions (head, tail, info, describe) to explore the data structure, data types, missing values, and summary statistics. b. Identify and address missing values in relevant features (e.g., Age). Explore techniques like dropping rows with missing values or imputation with mean/median.	**8**	**CO2 Apply**

c. Analyze the distribution of the "Fare" feature. Identify and handle potential outliers (e.g., using IQR method or visualization) if necessary. d. The "Cabin" feature might contain inconsistencies. Clean the data by extracting meaningful information (e.g., presence/absence of cabin) if possible. e. Create a new feature to categorize passengers into age groups Specified topics from chapter 4		
Module-3: Grouping and Correlation		
Grouping Datasets - Understanding groupby(), Groupby mechanics - Selecting a subset of columns, max and min, mean, Data aggregation - Groupwise operations, Renaming grouped aggregation columns, Group-wise transformations, Pivot tables and cross - tabulations: Pivot tables. Cross-tabulations Correlation: Introduction to Correlation, Types of analysis - Understanding univariate analysis, Understanding bivariate analysis, Understanding multivariate analysis. Case Study: Discussing multivariate analysis using the Titanic dataset **Practical Component:** Analyze Online Retail Customer Purchases using GroupBy: Dataset: Online Retail Dataset available from Kaggle (https://www.kaggle.com/datasets/lakshmi25npathi/online-retail-dataset a. Import pandas and load the "online_retail.csv" data into a DataFrame. b. Use info and describe to understand data types, identify potential missing values, and explore summary statistics for numerical features. c. Create new features based on customer demographics (e.g., Country, Age Group based on birth year). i. Use groupby to group data by "Country". Calculate: ii. Average order value per country iii. Total number of purchases per country iv. Most frequently purchased product categories (using value counts within groups) d. Create bar charts to visualize average order value. Specified Topics from chapter 6 & 7	**8**	**CO3 Apply**
Module-4: Time Series Analysis		
Understanding Time Series Dataset: Fundamentals of TSA - Univariate time series, Characteristics of time series data. Case study: TSA with open power system data: Data Cleaning, Time-based indexing, Visualising time series, Grouping time series data, Resampling time series data. **Practical Component:** Explore the structure of a time series dataset (e.g., stock prices). a. Import pandas and load the stock price data (date, open, high, low, close, volume) into a DataFrame. b. Clean the data and visualize trends using line charts. c. Calculate basic time series statistics. Specified topics from Chapter 8	**8**	**CO4 Apply**
Module-5: Hypothesis testing and Regression		
Hypothesis testing principles, statsmodel library, average reading time, types of hypothesis testing, T-test. Understanding regression - types of regression - simple linear regression, multiple linear regression, non linear regression, model development and evaluation- constructing a linear regression model, model evaluation, computing accuracy, implementing a multiple linear regression model. **Practical Component:**	**8**	**CO5 Apply**

Download a Twitter dataset containing tweets about a specific brand or event. a. Utilize libraries like NLTK or TextBlob to perform sentiment analysis on the tweets. b. Explore the distribution of positive, negative, and neutral sentiment. Identify keywords or phrases associated with each sentiment category. Specified topics from Chapter 9		

Course Outcomes: After completing the course, the students will be able to	
24CSE135.1	Apply EDA techniques to various real-world datasets.
24CSE135.2	Implement various data transformation methods to prepare data for further analysis.
24CSE135.3	Construct the most appropriate chart type based on the data characteristics and analysis goals.
24CSE135.4	Implement fundamental time series analysis techniques to explore patterns and make informed decisions.
24CSE135.5	Construct and evaluate simple linear regression models to understand the relationship between variables in real world datasets.

Text Books

1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, 2020 Edition, Packt Publisher.

Reference Books

1. Jake Vander Plas, Python Data Science Handbook: Essential Tools for Working with Data, First Edition 2016, Oreilly Publisher.
2. Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data Analysis for Social Scientists, Second Edition 2008, Wiley Publisher.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
50	IA Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 30 Marks. ● Average of 2 tests = 30 Marks	30
	Practical	Weekly Assessment	20
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Theory Exam	5 Questions to answer of 20 Marks (6M * 5= 30M) 2 Questions from each module with internal choice. Student should answer one full question from each module.	**30**
	Execution Part	Writeup – 20 Marks Conduction – 40 Marks Viva Voce – 10 Marks	**70**
		Total marks for the Course	**100**

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

Course Name: Object Oriented Programming Using Java		**Course Code: 24CSE136**
L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the fundamental principles of object-oriented programming using Java.
2	Develop Java applications using classes, objects, arrays, and strings.
3	Implement inheritance, interfaces, and handle exceptions effectively.
4	Apply multithreading and perform I/O operations in Java.
5	Use Java Collections framework and perform database connectivity using JDBC.

Module-1: Introduction to Java	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to Java: Features of OOP, Characteristics/Buzz words of Java, Java Environment: JDK, JVM, JRE, Fundamental Programming Structure in Java, Variables, Data Types, Operators & Expressions, Control Statements, Iteration Statements, Command Line Arguments. Single and Multidimensional Arrays. **Practical Component:** 1. Write a program to implement a simple ATM system where: a. A menu-driven interface is provided using switch statement b. The user can withdraw, deposit, or check balance c. Use while loop to keep the session active until the user exits 2. Develop a Java program that accepts employee details (name, age, department) as command line arguments and displays them in a formatted output. Validate inputs (e.g., age must be numeric and > 18).	**8**	**Apply CO1**
Module-2: Classes & Objects		
Classes & Objects: Defining Classes & Objects, Access Specifies, Constructors, Overloading Constructor, Method Overloading, Passing and Returning object form Method, new operator, finalize() method, this keyword, Static Keyword, Encapsulation, Polymorphism. **Strings:** Definition of String, String Literals, String Class, String Inbuilt Methods, StringBuffer & StringBuilder Class. **Practical Component:** 1. Design a class Student with private fields: name, rollNo, and marks. a. Use constructor overloading to allow both default and parameterized object creation. b. Apply encapsulation using getters and setters. c. Use the this keyword to resolve variable shadowing. d. Track total students using a static variable and method. e. Create another method that accepts a Student object as parameter and returns the same object with bonus marks added. 2. Create an abstract base class Shape with an abstract method area(). a. Derive classes Circle, Rectangle, and Triangle that override area() method using runtime polymorphism. b. Demonstrate calling overridden methods using a base class reference.	**8**	**Apply CO2**
Module-3: IO Programming & Files		

IO Programming: Introduction to Stream, Byte Stream, Character stream, Readers and Writers, File Class, File InputStream, File Output Stream, InputStreamReader. **Inheritance:** Defining a Inheritance, Types of Inheritance, Constructor in subclass, Method Overriding, super keyword, abstract keyword, final keyword. **Practical Component:** 1. Create an Employee class with fields: id, name, and salary. a. Use FileOutputStream and FileInputStream to write and read employee details from a file in byte stream format. b. Use the File class to check if the file exists or create a new one. c. Apply constructor in subclass by extending Employee to Manager with additional field department. 2. Design an abstract class Test with an abstract method generateResult(). a. Extend it with OnlineTest and OfflineTest classes. b. Use FileReader to read marks from a file and override the generateResult() method to calculate grade. c. Mark the generateResult() method as final in one subclass to restrict overriding.	**8**	**Apply CO3**
Module-4: Interfaces, Packages & Exceptions		
Interfaces & Packages: Defining a Interface, Implementing a Interface, Difference between Interface & Classes, Extending a Interface, Usage of Package, Classpath, Importing a Package. **Exceptions:** Definition of Exception, Classification of Exception, Structure of Try & catch block, Error Vs Exception, Throw Keyword, Throws Keyword, Finally Keyword, Custom Exception. **Practical Component:** 1. Create an interface PersonDetails with method display(). Extend it in another interface StaffDetails with method calculateSalary(). a. Implement StaffDetails in a class Professor. b. Simulate error scenarios like null values or negative salary using throw and throws keywords. c. Use a package university.staff and demonstrate use of classpath and import statements in a driver class. 2. Design a package student.registration with a class Student and interface Registrable. a. The interface should declare a method register(). b. Implement the interface and throw a custom exception InvalidRegistrationException if age is below 18. c. Use try-catch block and a finally block to confirm registration closure.	**8**	**Apply CO4**
Module-5: Multithreading & Enumerations		
Multithreading: Multi-Threaded Programming: What are threads? How to make the classes threadable? Extending threads, Implementing runnable, Synchronization, Thread priorities. Enumerations (Enumeration Fundamentals, The values() and valueOf() Methods), Type Wrappers, The values() and valueOf() Methods, Type Wrappers, Autoboxing. **Practical Component:** 1. Design a class TicketCounter where multiple users (threads) try to book tickets simultaneously. a. Use thread synchronization to prevent race conditions.	**8**	**Apply CO5**

b. Create user threads by both extending Thread and implementing Runnable. c. Assign thread priorities based on user type (e.g., VIP, Regular). d. Use an enum UserType { VIP, REGULAR } to distinguish users and use valueOf() to convert string input. 2. Create a class BankAccount that supports deposit and withdrawal. a. Spawn multiple threads to simulate transactions concurrently using Runnable. b. Ensure thread synchronization for consistency. c. Use enum TransactionType { DEPOSIT, WITHDRAW } and demonstrate values() and valueOf() methods. d. Show how thread priority affects execution order (optional based on thread scheduler).		

Course Outcomes: After completing the course, the students will be able to	
24CSE136.1	Understand object-oriented programming concepts and basics of JAVA to solve simple problems.
24CSE136.2	Construct a class involving data members and methods for the given scenario.
24CSE136.3	Apply the concepts of inheritance and Java I/O streams to implement Java applications
24CSE136.4	Apply the concepts of packages, interfaces and exception handling.
24CSE136.5	Develop Java applications using multithreading, enumerations and wrapper classes.

Text Books

1. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, - TMH.
2. Java Fundamentals A comprehensive introduction By Herbert Schildt, Dale Skrien, McGraw Hill Education.
3. Programming with Java A Primer – E.Balaguruswamy,Mc Grawhill.

Reference Books

1. Core Java Volume-I Fundamentals Horstmann & Cornell, - Pearson Education. - Eight Edition
2. Head First Java: A Brain-Friendly Guide, 2nd Edition- Kathy Sierra, Bert Bates.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
50	IA Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 30 Marks. ● Average of 2 tests = 30 Marks	30
	Practical	Weekly Assessment	20
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Theory Exam	5 Questions to answer of 20 Marks (6M * 5= 30M) 2 Questions from each module with internal choice. Student should answer one full question from each module.	**30**
	Execution Part	Writeup – 20 Marks Conduction – 40 Marks Viva Voce – 10 Marks	**70**
		Total marks for the Course	**100**

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Department of Computer Science and Engineering
IV Semester
Scheme of Teaching 2024 – 28 Batch

Sl. No.	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Hours Per Week	Credits	Examination		
					Lecture	Tutorial	Practical	Project					
					L	T	P	J			CIA	SEA	Total
1	BSC	24MAC141	Statistics, Probability and Graph Theory	Mathematics	2	2	-	-	4	3	50	50	100
2	PCI-C	24CSE142	Microcontroller and Internet of Things	CSE	2	-	2	-	4	3	50	50	100
3	PCI-C	24CSE143	Database Management System	CSE	3	-	2	-	5	4	50	50	100
4	PCI-P	24CSE144	Design and Analysis of Algorithms	CSE	3	-	2	-	5	4	50	50	100
5	PCI-P	24CSE145	Introduction to Machine Learning	CSE	3	-	2	-	5	4	50	50	100
6	PBL	24CSE146	Internship – I and IPL	CSE	-	-	2	2	4	2	100	-	100
7	HSS	24CIP147	CIPE	HSS	-	2	-	-	2	1	100	-	100
8	AEC	24SFT148	Soft Skills – II	HSS	-	2	-	-	2	1	100	-	100
Total					13	6	10	2	31	22	550	250	800

CIE: Continuous Internal Evaluation, SEE: Semester End Examination, NCMC: Non Credit Mandatory Course AICTE Activity Points to be earned by students admitted to BE day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other institutions and Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to BNMIT. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

BSC → Basic Science	PW → Project Work	MAT → Mathematics	PEC → Professional Elective	INT → Internship
PBL → Project Based Learning	OEC → Open Elective	HUM → Humanities and Social Science	PCC → Professional Core Course	PCI → Professional Core Course Integrated
AEC → Ability Enhancement Course	UHV → Universal Human Values			

Head of the Department
Dept. of Computer Science & Engineering
BNM Institute of Technology
Bangalore - 560 070

Additional Director & Principal
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B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: IV

Course: Statistics, Probability and Graph theory

Course Code: 24MAC141 (Common to CSE, ISE, AIML)

L:T:P:J	**2:2:0:0**	**CIA: 50**
Credits:	**03**	**SEA: 50**
Hours:	**40**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	Provide an insight into applications of Graph Theory, Curve fitting & Statistical methods.
2	Develop the knowledge of probability, joint probability distribution and Queuing theory occurring in digital signal processing, design engineering and micro wave engineering.

Module-1: Curve fitting & Statistical methods	No. of hours	Blooms cognitive Levels
Examples from Engineering that require curve fitting and statistical methods. **Curve Fitting:** Curve fitting by the method of least squares-fitting the curves of the form: $y = ax+b$, $y = ax^b$ *and* $y = ax^2 + bx + c$. **Statistical methods:** Introduction to Moments, Skewness, Kurtosis and problems. Karl Pearson's coefficient of correlation and lines of regression. *Experiential Learning component: Problems on curve fitting and statistical methods*	**L: 04** **T: 04**	**L1** **L2** **L3**
Module-2: Probability distributions & Joint probability distribution		
Examples from Engineering that require Probability and Joint probability distribution **Probability distributions:** Review of basic probability theory. Discrete and continuous Random variables, probability mass/density functions (definitions only). Binomial, Poisson, exponential and normal distributions (without proof). **Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. *Experiential Learning component: Problems on Binomial, Poisson, Exponential and Normal distributions*	**L: 04** **T: 04**	**L1** **L2** **L3**
Module-3:Markov chain & Sampling theory		
Examples from Engineering that require Markov Chain and Sampling Theory **Markov chain**: Introduction to Stochastic process, Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov Chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states, Markovian processes. **Sampling theory**: Introduction to sampling theory, testing of hypothesis, level of significance, confidence limits, test of significance of mean and difference of means for large samples-z-test, test of significance of small Samples-Student's t- distribution. *Experiential Learning component: Problems on Markovian processes and, Sampling Theory*	**L: 04** **T: 04**	**L1** **L2** **L3**
Module-4: Queuing theory		
Examples from Engineering that require queueing theory Introduction, birth and death process, Kendall's Notation, Symbolic representation of a queuing model, single server Poisson queuing model with infinite capacity (M/M/1: ∞/FCFS), when $\lambda_n = \lambda$ and $\mu_n = \mu(\lambda < \mu)$, Multiple server Poisson queuing model with infinite capacity (M/M/S: ∞/ FCFS), when $\lambda_n = \lambda$ for all $n, (\lambda < S\mu)$, *Experiential Learning component: Problems on* (M/M/1: ∞/FCFS) and (M/M/S: ∞/ FCFS) queuing models	**L: 04** **T: 04**	**L1** **L2** **L3**
Module-5: Graph theory		
Examples from Engineering that require graph theory Basic concepts, types of graphs, order and size of a graph, in-degree and out-degree, bipartite-graphs, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, sub-graphs, isomorphic graphs. Matrix representation of graphs, adjacency matrix, incidence matrix. Planar graphs: definition, characterization of planar graphs, Kuratowski's theorem, Euler's formula and consequences. *Experiential Learning component: Problems on detection of planar and non-planar graphs*	**L: 04** **T: 04**	**L1** **L2** **L3**

Course Outcomes: After completing the course, the students will be able to

CO 1:	Make use of correlation and regression analysis to fit a suitable mathematical model for the statistical data.
CO 2:	Apply discrete and continuous probability and joint probability distributions in analyzing the probability models arising in engineering field.
CO 3:	Use Markov chain in prediction of future events and demonstrate the validity of testing the hypothesis.
CO 4:	Acquire skills in analyzing queuing models.
CO 5:	Apply the knowledge of Graph Theory in Network modeling, electrical network and computational algorithms.

CO - PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2			2							
CO 2	3	2			2							
CO 3	3	2			2							
CO 4	3	2			2							
CO 5	3	2			2							

Reference Books:

1. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition(Reprint), 2016.
2. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
3. S. D. Sharma : "Operations Research", Kedar Nath Ram Nath & Co. Meerut, 2014.
4. T. Veerarajan : Probability, Statistics and Random processes, McGraw Hill Education(India) Private Limited, Third edition, Nineteenth reprint 2017.
5. C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
6. B. V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
7. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016.
8. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2000.

Web links and Video Lectures:

1. https://nptel.ac.in/courses/111104098
2. https://www.youtube.com/watch?v=1YkfeR05YXY
3. https://archive.nptel.ac.in/courses/111/104/111104079/
4. https://www.youtube.com/watch?v=xGkpXk-AnWU
5. https://archive.nptel.ac.in/courses/106/104/106104170/

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: IV

Course Name: Microcontroller and Internet of Things		**Course Code: 24CSE142**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the fundamentals of ARM-based systems, including programming modules with registers and the CPSR.
2	Use various instructions to program the ARM controller.
3	Program various embedded components using instruction set
4	Understanding the concepts, architecture, and applications of IoT.
5	Understanding Installing and configuring the Node-RED.

Module1: Microprocessors versus Microcontrollers	**No. of Hours**	**Blooms Ccognitive Levels with CO mapping**
Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. **ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions. **Laboratory Component:** Using Keil software, observe the various registers, dump, CPSR, with a simple ALP programme	**8**	**Understand CO1**
Module-2: ARM Instruction Set		
Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants. **Laboratory Component: Sample software programs using instruction set:** Ex: Write a program to find the sum of the first 10 integer numbers. Write a program to find the factorial of a number	**8**	**Apply CO2**
Module-3:		
ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs. **Laboratory Component:** Write a program to add an array of 16-bit numbers and store the 32-bit result in internal RAM. Write a program to find the square of a number (1 to 10) using a look-up table.	**8**	**Apply CO2**
Module-4: Introduction to IoT and Node-RED		
Overview of IoT: concepts, architecture, and applications, Introduction to Node-RED: features, interface, and use cases, Installing Node-RED (Windows/Linux/Raspberry Pi). Node-RED Basics: Understanding nodes, flows, and messages, Working with basic nodes: inject, debug, function, delay, and template, Deploying and managing flows	**8**	**Apply CO3**
Module-5: Data Acquisition and Processing and Dashboard Development		

Connecting sensors (via Raspberry Pi or Arduino), Using MQTT protocol for IoT communication Parsing and processing sensor data in Node-RED, Storing data (to files, databases like Influx DB, or cloud), Installing and configuring the Node-RED dashboard, Creating user interfaces (gauges, charts, switches, sliders),Real-time visualization of sensor data	**8**	**Apply CO3**

Course Outcomes: After completing the course, the students will be able to	
24CSE142.1	Understand the fundamentals of ARM-based systems, including programming modules with registers and the CPSR.
24CSE142.2	Make use of Instruction sets and addressing modes learnt to write simple programs.
24CSE142.3	Apply the knowledge gained for Programming ARM controller for real time applications.
24CSE142.4	Demonstrate the ability to create flows using various nodes for basic input-output and data processing tasks.
24CSE142.5	Integrate Node-RED with sensors, APIs, and cloud services for real-time data acquisition and control.

Text Books

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Learn IoT programming using Node-Red by Bernardo Ronquillo Japon, bpb publication

Reference Books

1. Raghunandan. G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	Total Number of Test: 3 Each Theory test will be conducted for 30 marks Average of 3 tests = 30 Marks (Scaled down to 15 marks)	15
	Lab Test		15
	Weekly Assessment		10
	Assignment / AAT		10
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	5 Questions to answer, each of 20 marks. 2 Questions from each module with internal choice. Student should answer one full question from each module.	20*5=100 Scale down to **50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Dept. of Computer Science & Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: IV

Course Name: Database Management System		**Course Code: 24CSE143**
L: T: P: J	3:0:2:0	**CIA Marks:** 50
Credits:	4	**SEA Marks:** 50
Hours/Week (Total)	50	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand fundamental concepts, terminology and application of databases, SQL and NoSQL
2	Design concepts and creation of relational databases using relation algebra.
3	Practice SQL programming through a variety of database problems.
4	Demonstrate the use of Normalization, concurrency and transactions in database.

Module-1: Database System Concepts, Data Modeling	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Databases and Databases Users: Characteristics of database Approach, Advantages of using the DBMS Approach. Database System Concepts and Architecture: Data Models-Schemas, Three-Schema Architecture and Data Independence, Database Languages, and Interfaces. Data Modeling Using the Entity-Relationship (ER) Model: Entity Types-Entity sets- Attributes and Keys, Relationship types, structural Constraints, Weak Entity Types. converting the database specification in E/R notation to the relational schema **Practical component:** Draw ER Diagram for the following Databases using GitMind software. Order Database Library Database Bank Database	10	**Understand CO1**
Module-2: Relational Data Model and Relational Algebra		
Concepts of relations, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, various types of joins, division, example queries **Practical component:** Create Schema, insert at least 5 records in each table and add appropriate constraints for the following Library Database using ORACLE or MySQL DBMS under LINUX/Windows environment BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Name, Address, Phone) BOOK_COPIES (Book_id, Branch_id, No-of_Copies) BOOK_LENDING (Book_id, Br_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc.	**10**	**Apply CO2**

2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2020 to Jun 2022. 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.		
Module-3: SQL		
Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT – DELETE and UPDATE Statements in SQL, Additional features in SQL **More SQL: Complex Queries, Triggers, Views:** Complex SQL Retrieval Queries, Specifying Constraints as Assertions and actions as Triggers, Views (Virtual Tables) in SQL. **Practical component:** Create Schema, insert at least 5 records for each table and add appropriate constraints for the following Order Database using ORACLE or MySQL DBMS under LINUX/Windows environment. SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (C_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, C_id, S_id) Write SQL queries to 1. Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesman who had more than one customer. 3. List all the salesman and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order.	**10**	**Apply CO3**
Module-4: Functional Dependencies and Normalization		
Basics of Functional Dependencies and Normalization for Relational Database: Functional Dependencies, Armstrong's axioms for FD's, Equivalent Decompositions, closure of a set of FDs, minimal covers, Normal forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce- Codd Normal Forms [BCNF] **Practical component:** Create Schema, insert at least 5 records for each table and add appropriate constraints for the following Company Database using ORACLE or MySQL DBMS under LINUX/Windows environment. EMPLOYEE (SSN, Name, Address, Sex, Salary, Super SSN, D No) DEPARTMENT (D No, D Name, Mgr. SSN, Mgr. Start Date) DLOCATION(D No,D Loc) PROJECT (P No, P Name, P Location, D No) WORKS_ON(SSN, P No, Hours) Write SQL queries to 1. Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project. 2. Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise. **3.** Find the sum of the salaries of all employees of the 'Accounts' department,	**10**	**Analyze CO4**

as well as the maximum salary and the average salary in this department.		
Module-5: Transaction Processing, Concurrency Control, NoSQL		
Introduction to Transaction Processing –Introduction to Transaction Processing, Desirable Properties on Transactions (ACID) **Concurrency Control Techniques:** Transactions and Schedules, Serializability, Precedence Graphs, Concurrency, Lock Based Protocols: 2PL, Strict 2PL Protocols, Deadlocks - Detection and Prevention **NoSQL:** SQL v/s NoSQL, The Emergence of NoSQL, BASE Properties, Data Models: Relationships, Graph Database, Schema less Database.	**10**	**Analyze CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE143.1	Understand the Database System Concepts along with Data Modeling Using the Entity-Relationship (ER) Model
24CSE143.2	Apply the concepts of relations on RDBMS, constraints, joints using relational algebra operators.
24CSE143.3	Apply Structured Query Language for database manipulation.
24CSE143.4	Analyze functional dependencies to normalize relations of relational database
24CSE143.5	Analyze transactions processing, schedules protocols, serializability issues, deadlocks in DBMS and concepts of NoSQL with its advantages

Text Books

1. Ramez Elmasari, Shamkant B Navathe "Fundamentals of Database Systems", Pearson, Seventh Edition 2017.
2. "Database System Concepts", Silberschatz, H Korth, S Sudarshan, 6th Edition, McGraw-Hill, 2010
3. Pramod J Sadalage, Martin Fowler, "NOSQL Distilled", Pearson, 2013

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	Total Number of Test: 3 Each Theory test will be conducted for 30 marks Average of 3 tests = 30 Marks (Scaled down to 15 marks)	15
	Lab Test		15
	Weekly Assessment		10
	Assignment / AAT		10
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	5 Questions to answer, each of 20 marks. 2 Questions from each module with internal choice. Student should answer one full question from each module.	20*5=100 Scale down to **50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: IV

Course Name: Design and Analysis of Algorithms		**Course Code: 24CSE144**
L:T:P:J	3:0:2:0	**CIA Marks:** 50
Credits:	4	**SEA Marks:** 50
Hours/Week (Total)	50	**SEA Duration:** 03Hours

Course Learning Objectives: The students will be able to

1	Analyze the asymptotic performance of algorithms.
2	Understand the concept of designing an algorithm.
3	Synthesize efficient algorithms in common engineering design situations.
4	Analyze the efficiency of programs based on time complexity.

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Analysis of Algorithmic Efficiency: Analysis framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. **Practical Programs** 1 Implement Java program to find Factorial of a given number. 2 Implement Java program to print Fibonacci series of a given number. 3 Implement Java program to check whether elements in an array is unique or not. 4 Implement a Java program for Tower of Hanoi problem. 5 Implement a Java program to generate list of prime numbers using Sieve of Eratosthenes.	**10**	**Analyze CO1**
Module-2: Brute Force, Divide and Conquer, Decrease and Conquer		
Brute Force: Sequential Search, Brute Force String Matching **Divide and Conquer:** General method, Recurrence equation, Binary search, Finding the Maximum and Minimum, Mergesort, Quicksort **Decrease and Conquer:** Topological sort using DFS & source removal method. **Practical Programs** 1 Implement Java program for Linear search and find the time required to search the key element. 2 Develop a Java program to search a key in a given set of elements using Binary search method and find the time required to find the key.	**10**	**Analyze CO2**

3 Develop a Java program to sort a given set of elements using Merge sort method and find the time required to sort the elements. 4 Develop a Java program to sort a given set of elements using Quick sort method and find the time required to sort the elements. 5 Develop a Java program to find Maximum and Minimum using divide and conquer technique and find the time required to find the elements.		
Module-3: Greedy Method		
General method, Fractional Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm. Single source shortest paths: Dijkstra's Algorithm. Optimal Tree problem: Huffman Trees and Codes. **Practical Programs** 1 Develop a Java program to find maximum profit using Knapsack technique. 2 Implement Java program for Job Sequence problem using Greedy method. 3 Implement a Java program to construct a minimum cost spanning tree using Prim's algorithm. 4 Implement a Java program to construct a minimum cost spanning tree using Kruskal's algorithm. 5 Implement a Java program to find a single source shortest path using Dijkstra's algorithm.	**10**	**Apply CO3**
Module-4: Dynamic Programming		
General method with Examples, Multistage Graphs using backward & forward approach, Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, 0/1 Knapsack problem, Travelling Sales Person problem. **Practical Programs** 1 Implement a Java program to find all-pairs shortest path using Floyd's algorithm. 2 Implement a Java program to find a transitive closure of directed graph using Warshall's algorithm. 3 Develop a Java program to implement 0/1 knapsack using Dynamic Programming. 4 Develop a Java program to find a single source shortest path using Bellman Ford algorithm. 5 Develop a Java program to implement travelling sales man problem using Dynamic Programming.	**10**	**Analyze CO4**
Module-5: Backtracking, Branch and Bound, NP Problems		
Backtracking: General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. **Branch and Bound:** Assignment Problem, Travelling Sales Person problem. **NP-Complete and NP-Hard problems:** Basic concepts, non-deterministic	**10**	**Analyze CO5**

algorithms, P, NP, NP-Complete and NP-Hard classes. **Practical Programs** 1 Develop a Java program to implement N-Queen problem using Backtracking technique. 2 Design and implement a Java program for Sum-Subset problem. 3 Design and implement Java program to find all Hamiltonian Cycles in a connected undirected graph (G) of n vertices.		

Course Outcomes: After completing the course, the students will be able to	
24CSE144.1	Analyze the asymptotic runtime complexity of algorithms by using mathematical relations that help to identify them in specific instances.
24CSE144.2	Analyze time complexities of algorithms using brute force and divide and conquer technique.
24CSE144.3	Apply various problem-solving methodologies such as greedy, decrease and conquer to solve a given problem.
24CSE144.4	Analyze the dynamic programming strategy to estimate the computational complexity of different algorithms.
24CSE144.5	Analyze Backtracking and Branch and Bound algorithm design approaches to find best possible solution.

Text Books
1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009, Pearson. 2. Computer Algorithms / C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
Reference Books
1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI. 2. Data Structures and Algorithms using C, R.S.Salaria, 5th Edition, Khanna Publication.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCI</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="3">CIA (50)</th><th colspan="2">SEA
Conduction:100M
Reduced to:50 M</th></tr>
<tr><th></th><th>I</th><th>II</th><th>PART A</th><th>PART B</th></tr>
<tr><td rowspan="4">Conduction</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="2">IA Test</td><td>30</td><td>30</td><td rowspan="3">30 Marks</td><td rowspan="3">70 Marks</td></tr>
<tr><td colspan="2">Average of two tests– 30 M</td></tr>
<tr><td>Continuous Assessment</td><td colspan="2">Weekly Assessment-20 marks</td></tr>
<tr><td colspan="3">Total – 50 Marks</td><td colspan="2">Total – 50 Marks</td></tr>
</table>

i) CIA: 50%

IA Test: 2 IA tests - each of 30 Marks – Average of 2 tests	30 Marks
Practical Lab record – 10 Marks Performance – 05 Marks Viva – 05 Marks	20 Marks
Total	**50 Marks**

ii) SEA:50%

Question Paper:

Theory part	5 questions to answer each of 6 Marks 2 questions from each module with internal choice Student should answer one full question from each module	6 M x 5 = 30 Marks
Execution part	Writeup - 20 Marks Conduction – 40 Marks Viva-Voce - 10 Marks	70 Marks
	Total	**100 Marks Reduced to 50 Marks**

Note: No Assignment and AAT

BNM Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: IV

Course Name: Introduction to Machine Learning		**Course Code: 24CSE145**
L: T: P: J	3:0:2:0	**CIA Marks:** 50
Credits:	4	**SEA Marks:** 50
Hours/Week (Total)	50	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the types of classifications and dimensionality reduction techniques.
2	To become acquainted with regression, classification, and error functions.
3	To become acquainted with the concepts of ensemble, clustering and reinforcement learning.
4	Show scholarly expertise in the application of and analysis of machine learning algorithms to address various learning challenges.

Module-1: Introduction to Machine Learning	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction, What is Human Learning, Types of Human learning, What is Machine Learning, Types of Machine Learning, Applications of Machine Learning, Issues in machine Learning, Basic Types of Data in Machine Learning, Exploring Structure Data, Data Quality and Remediation.	**10**	**Understand CO1**
Module-2: Supervised Machine Learning - I		
Introduction, Examples of Supervised Machine Learning, Classification Model, Classification Learning Steps, Classification Algorithms: KNN, Naïve Bayes, Support Vector Machine, Decision Tree: Bagging & Boosting. Sample Programs: 1. Develop a program to implement the K-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. 2. Apply the working of Naïve Bayes using a suitable dataset.	**10**	**Apply CO2**
Module-3: Supervised Machine Learning - II		
Introduction to Neural Networks, Perceptron, Multi-layer Perceptron, Backpropagation. Regression: Introduction to Regression, Example of Regression. Regression Algorithms: Linear Regression, Logistic Regression. Sample Programs: 1. Analyze the working of perceptron and error functions using suitable datasets. 2. Build an Artificial Neural Network by implementing the Backpropagation algorithm. 3. Construct a code for Linear & Logistic Regression.	**10**	**Apply CO3**
Module-4: Unsupervised Machine Learning - I		
Introduction to Unsupervised, Application of Unsupervised, Clustering: K-Means, K-Medoid, Hierarchical, EM algorithm, Density-based methods-DBSCAN. Sample Programs: 1. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.	**10**	**Apply CO4**
Module-5: Unsupervised Machine Learning - II		
Introduction to Association Analysis, Apriori Algorithm, Advantages and Disadvantages of Apriori Algorithm.	**10**	**Apply CO5**

Introduction to Dimensionality Reduction, Principal Component Analysis, Linear Discriminant Analysis, Singular Value Decomposition. Sample Programs: 1. Implement Apriori algorithm by using suitable market basket dataset. 2. Apply PCA and any classification algorithm on suitable datasets.		

Course Outcomes: After completing the course, the students will be able to	
24CSE145.1	Understand the basic concepts of Machine Learning.
24CSE145.2	Apply supervised classification learning models on real-world applications.
24CSE145.3	Apply supervised neural networks and regression learning models on real-world applications.
24CSE145.4	Apply unsupervised clustering models on real-world applications.
24CSE145.5	Apply unsupervised association analysis and dimensionality reduction models on real-world applications.

Text Books

1. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Fifth Edition 2020, Pearson Publisher.
2. Tom M. Mitchell, -Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
3. Ethem Alpaydin, "Introduction to machine learning", second edition, PHI publication, 2010
4. Shai Vaingast, " Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd Edition, 2014.

Reference Books

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
2. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. John L. Semmlow, Benjamin Griffel, Bio-signal and Medical Image Processing, 3rd Ed, CRC Press, 2014.
4. Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006
5. Stephen Marsland, - Machine Learning: An Algorithmic Perspective, Second Edition, 2014.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
50	Test	Total Number of Test: 2 Each Theory test will be conducted for 30 Marks Average of 2 tests = 30 Marks	30
	Weekly Assignment	Lab Record	10
		Performance	5
		Viva	5
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Theory Exam	5 Questions to answer of 20 Marks (6M * 5= 30M) 2 Questions from each module with internal choice. Student should answer one full question from each module.	30
	Execution Part	Writeup – 20 Marks Conduction – 40 Marks Viva Voce – 10 Marks	70
		Total marks for the Course	**100**

B. N. M. Institute of Technology
An Autonomous Institute Under VTU

Department of Computer Science and Engineering
V Semester
Scheme of Teaching 2024 – 28 Batch

Sl. No.	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Hours Per Week	Credits	Examination		
					Lecture	Tutorial	Practical	Project					
					L	T	P	J			CIA	SEA	Total
1	PCC	24CSE151	Software Project Management and Finance	CSE	2	2	-	-	4	3	50	50	100
2	PCC	24CSE152	Automata Theory and Computation	CSE	2	2	-	-	4	3	50	50	100
3	PCC	24CSE153	Computer Networks	CSE	3	-	2	-	5	4	50	50	100
4	PCI-P	24CSE154	Natural Language Processing	CSE	3	-	2	-	5	4	50	50	100
5	PCI-C	24CSE155	Cloud Computing and Applications	CSE	2	-	2	-	4	3	50	50	100
6	OEC	24CSE156X	Open Elective - I	CSE	2	-	2	-	4	3	50	50	100
7	AEC	24CSE157	Employability Skills – I [Technical]	T&P	-	2	-	-	2	1	100	-	100
8	INT	24CSE158	Internship - II	CSE	-	-	2	2	4	2	100	-	100
Total					14	6	10	2	32	23	500	300	800

Open Elective – I			
24CSE1561	Operating System	24CSE1562	Object Oriented Programming Using Java
24CSE1563	Efficient Algorithms and Data Structures using Java	24CSE1564	Database Management System.

CIE: Continuous Internal Evaluation, SEE: Semester End Examination, NCMC: Non Credit Mandatory Course AICTE Activity Points to be earned by students admitted to BE day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other institutions and Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to BNMIT. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

BSC → Basic Science	PW → Project Work	MAT → Mathematics	PEC → Professional Elective	INT → Internship
PBL → Project Based Learning	OEC → Open Elective	HUM → Humanities and Social Science	PCC → Professional Core Course	PCI → Professional Core Course Integrated
AEC → Ability Enhancement Course	UHV → Universal Human Values			

Head of the Department
Dept. of Computer Science & Engineering
BNM Institute of Technology
Bangalore - 560 070

23/07

Additional Director & Principal
BNM Institute of Technology
Bangalore-560 070

B.N.M Institute of Technology

Dept. of Computer Science & Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Software Project Management and Finance		**Course Code: 24CSE151**
L: T: P: J	**2:2:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4 (40)**	**SEA Duration:** 03 Hours

Pre-Requisites: The foundation of Mathematics, Data structures , Algorithms

Course Learning Objectives: The students will be able to

1	Identify ethical issues and explain why they are of concern to software engineers.
2	Apply estimation techniques, schedule project activities and compute pricing
3	Identify software quality parameters and quantify software using measurements and metrics.
4	Recognize the need for agile software development, describe agile methods, apply agile practices and plan for agility.

Module-1: : Introduction, Software Process, Requirements Engineering	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: Software Crisis, Need for Software Engineering. Software Engineering Ethics. Case Studies (Self Study Component). **Software Processes**: Models: Waterfall Model, Incremental Model, and Spiral Model, Process activities. **Requirements Engineering**: Requirements Engineering Processes, Functional and non-functional requirements. The Software Requirements Document. Requirements Specification. Requirements validation, Requirements Management.	**8**	**Apply CO1**
Module-2: System Models, Design & Implementation, Software Testing		
System Models: Structural models, Behavioral models, UML modeling using Star UML tool. **Design and Implementation**: Introduction to RUP, Design Principles. **Software Testing:** Development Testing, Test-driven development, Release Testing, User Testing	**8**	**Apply CO2**
Module-3: Project Management, Project Planning & Quality Management		
Project Management: Risk Management, Managing People, Teamwork **Project Planning:** Software pricing, Plan-driven development, Project scheduling. **Quality management:** Software quality, Reviews, and inspections. Software measurement and metrics, Software standards.	**8**	**Analyze CO3**
Module-4: Agile Software Development		
Agile Software Development: Agile Methods, SCRUM, Plan-driven and agile development, Extreme Programming, Agile Project Management, Scaling agile methods.	**8**	**Apply CO4**
Module-5: Project Financial Management		
How to Manage Project Finances: Cost Estimating-Work Breakdown Structure (WBS), Cost Budgeting-Cost Aggregation, Parametric Estimating, Infrastructure and Overheads, Cost Control- Change Control, Resource Management. **Performance Measurement and Analysis:** Cost Variance, Earned Value, Schedule variance, Cost Performance Index (CPI), Schedule Performance Index (SPI)	**8**	**Analyze CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE151.1	Identify and apply various Software Process Models.
24CSE151.2	Apply various System Models for design, implementation and Software Testing.
24CSE151.3	Analyze Software Project management concepts for software development and develop project planning using a Gantt chart.
24CSE151.4	Identify the need for agile software development, describe agile methods and apply agile practices.
24CSE151.5	Analyze the basic financial concepts for a project plan.

Text Books

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012. (Listed topics only from Chapters 1, 2, 4, 5, 7, 23, and 24)
2. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
3. Financial Management -Prasanna Chandra, 9/e, TMH.

Reference Books

1. Software Engineering Ian Sommerville Pearson Education 9th Edition, 2012
2. Software Engineering-A Practitioner approach Roger S. Pressman Tata McGraw Hill 7th Edition
3. An Integrated Approach to Software Engineering Pankaj Jalote Wiley India

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	• Total Number of Test: 3 • Each Theory test will be conducted for 30 marks • Average of 3 tests = 30 Marks	30
	Assignment	Activity to demonstrate all the phases of the software development life cycle (Poster Presentation)	10
	AAT	Conduct quiz after 1st IA /Assignments	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science & Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Automata Theory and Computation **Course Code: 24CSE152**

L: T: P: J	**2:2:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4 (40)**	**SEA Duration:** 03 Hours

Pre-Requisites: The concepts of Set theory, Relations, Functions, Pigeon Hole Principle

Course Learning Objectives: The students will be able to

1	Introduce core concepts in Automata and Theory of Computation
2	Identify different Formal language Classes and their Relationships
3	Design Grammars and Recognizers for different formal languages
4	Prove or disprove theorems in automata theory using their properties
5	Determine the decidability and intractability of Computational problems

Module-1: Introduction to theory of Computation, Languages and Strings	**No. of Hours**	**Blooms Cognitive Levels**
Basic terminologies used in Strings, Languages, A Language Hierarchy, **Finite State Machines (FSM)**: Deterministic FSM,Designing FSM, Nondeterministic FSMs, Minimizing FSMs, Finite State Transducers,.	**8**	**Understand /Apply CO1**
Module-2: Regular Expressions		
What is a RE?, Kleene's theorem, Applications of REs, Manipulating and Simplifying RE, Regular Grammars, Regular Languages (RL) and Non-regular Languages ,To show that a language is regular, Closure properties of RLs, to show some languages are not RLs.	**8**	**Apply CO2**
Module-3: Context Free Grammars		
Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, simplifying CFGs, Derivation and Parse trees, Ambiguity, Normal Forms. Pushdown Automata (PDA): Deterministic and Non-deterministic PDAs, alternatives that are not equivalent to PDA.	**8**	**Apply CO3**
Module-4: Context-Free Languages and Turing Machine		
Showing a language is context-free, Pumping theorem for CFL, Important closure properties of CFLs, **Turing Machine**: Turing machine model, Representation, Language acceptability by TM, design of TM	**8**	**Apply CO4**
Module-5: Decidability		
Variants of Turing Machines (TM), The model of Linear Bounded automata. halting problem of TM, Post correspondence Growth rate of functions, the classes of P and NP, Quantum Computation: quantum computers, Church-Turing thesis.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE152.1	Understand the fundamental concepts in theory of computation, Design of finite state machines for the given language
24CSE152.2	Design of Regular expressions to recognize FSM
24CSE152.3	Design Grammars and Automata (recognizers) for different language classes
24CSE152.4	Use Reduction techniques for translating complex problems into a formal computational model like PDA and TM for better solution
24CSE152.5	Classify a problem with respect to different models of Computation.
24CSE152.6	Build automata for real time application and test using JFLAP tool

Text Books

1. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson education,2012/2013
2. K L P Mishra, N Chandrasekaran , 3rd Edition, Theory of Computer Science, PhI, 2012.

Reference Books

1.John E Hopcroft, Rajeev Motwani, Jeffery D Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education, 2013
2. Michael Sipser : Introduction to the Theory of Computation, 3rd edition, Cengage learning,2013
3. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013
4. Peter Linz, "An Introduction to Formal Languages and Automata", 3rd Edition, Narosa Publishers, 1998
5. Basavaraj S. Anami, Karibasappa K G, Formal Languages and Automata theory, Wiley India, 2012

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Build automata for real time application and test using JFLAP tool	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science &Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: COMPUTER NETWORKS		**Course Code: 24CSE153**	
L:T:P:J	**3:0:2:0**	**CIA**	**: 50**
Credits:	**4**	**SEA**	**: 50**
Hours:	**50**	**SEA Duration Hours**	**: 3**

Course Learning Objectives: The students will be able to

1	Explain with the basics of data communication and various types of computer networks.
2	Demonstrate Application layer protocols.
3	Apply transport layer services to understand UDP and TCP protocols.
4	Analyse the working of routers, IP and Routing Algorithms as part of network layer.
5	Demonstrate Medium Access Control protocols for reliable and noisy channels.

Module-1 Introduction	**No. of hours**	**Blooms cognitive Levels**
Introduction to networks, Data communication: Components, Data representation, Data Flow, Networks: Network criteria, physical structures, Network types, Switching, Internet, Network models: Protocol layering: Scenarios, principles, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP. Switching: Circuit switching and Packet switching. 1. Introduction to Network Tools such as Wireshark, ssh with sample experiments. 2. Introduction to Cisco packet tracer with sample experiments.	**10 hours**	**Understand**
Module-2: Application Layer		
Application Layer: Network Application Principles, The Web and HTTP - Overview, HTTP Message Format, Web Caching, Cookies and Authentication, DNS Services, DNS Hierarchy, DNS Records, SMTP. 1. Understand Persistent and Non-Persistent HTTP Connections and Corresponding Performance Impact. 2. Understanding working of HTTP headers: Conditional GET, Cookies and Authentication. 3. DNS Server Implementation (using Apache server setup)	**10 hours**	**Apply**
Module-3: Transport Layer		

Transport Layer: Introduction to Transport Layer Services, UDP Protocol, Principles of Reliable Data Transfer - Stop – N – Wait protocol, Sliding Window Concepts – Go Back N Protocol, TCP Features, Header, Connection Management, Flow Control, Error Control and Congestion Control. 1. Write a program to create a simple web server - client system using socket programming. 2. Develop a simple Web server in Python that is capable of processing only one request. Specifically, your Web server will a) create a connection socket when contacted by a client (browser); b) receive the HTTP request from this connection; c) parse the request to determine the specific file being requested; d) get the requested file from the server's file system; e) create an HTTP response message consisting of the requested file preceded by header lines; and f) send the response over the TCP connection to the requesting browser. If a browser requests a file that is not present in your server, your server should return a "404 Not Found" error message.	**10hours**	**Apply**
Module-4: Network Layer		
Network Layer and Internet Protocol: IPV4 and IPv6 Datagram Format, Fragmentation, Addressing, Subnet Principles, Forwarding Mechanisms, DHCP, NAT, ICMP, ARP, IP Static Routing, Hierarchical Addressing and Route Aggregation, Longest Prefix Match, Introduction to IPTABLES, Introduction to IPV6. 1. Designing and Simulation of Network Topology using Cisco Packet Tracer. 2. IPV4 Addressing: Configuring static IP addresses, configuring automatic IP addressing (DHCP), Testing connectivity (ICMP) using Cisco packet tracer. 3. IPV6 Addressing (IPv6 Configuration and Static Routing) using a real router. 4. ICMP Redirect and Study: 5. Understanding TTL expiry: Using Cisco packet tracer understand the life of packet in internet.	**10 hours**	**Analyze**
Module-5: Data link and Physical Layer		
Link Layer and Physical layer: Introduction to Link Layer, Introduction to Error Detection and correction-CRC, Datalink layer functions-framing, flow and error control, Introduction to MAC Protocols, Aloha, CSMA/CD, CSMA/CA. Introduction to Ethernet LAN and its characteristics, Wireless LAN and its characteristics. Introduction to Analog transmission and Digital transmission-line coding schemes (NRZ,Manchester,RZ), Transmission impairment, Data rate limits, Network performance parameters. 1. Use of Hubs, Switches and Routers in network using cisco packet tracer / real components. 2. Implementation of stop and wait protocol using C/Python. 3. Setup an Ethernet LAN using different types of cables and compare the throughput using cisco packet tracer. 4. Setup an ESS using cisco packet tracer and check the performance.	**10 hours**	**Apply**

Course outcomes: After completing the course, the students will be able to	
COs	**Statement**
24CSE153.1	Understand the concepts of digital communication to and the working principles of physical layer
24CSE153.2	Apply principles of Application layer protocols.
24CSE153.3	Apply Transport Layer Services and infer TCP and UDP protocols.
24CSE153.4	Analyze IP and routing protocols in network layer.
24CSE153.5	Apply data link layer protocols with fundamentals of digital communication

Text Books

1. Data Communication and Networking, Behrouz A.Forouzan, McGraw Hill, 5th Edition, 2013.
2. James F. Kurose and Keith W. Ross: Computer Networking: A TopDown Approach, 8th edition, Addison-Wesley, 2021.
3. Data and Computer Communication, William Stallings, 10th Edition, Pearson Education, 2013.
4. Introduction to Data Communications and Networking – Wayne Tomasi, Pearson Education, 5th Edition, 2011.
5. Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
6. Tanenbaum: Computer Networks, 5th Edition, Pearson Education/PHI, 2010.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/106/105/106105183/
2. https://www.netacad.com/courses/packet-tracer
3. https://www.wireshark.org/docs/wsug_html_chunked/ChapterIntroduction.html

Marks Distribution for assessment

<table>
<tr><th rowspan="2">PCI</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th>SEA Conduction : 100marks Reduced to 50marks</th></tr>
<tr><td></td><td>I</td><td>II</td><td>III</td><td rowspan="4">Five questions with each of 20 Marks (with internal choice). Student should answer one full question from each module.</td></tr>
<tr><td rowspan="4">CONDUCTION</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="3">Theory</td><td>30</td><td>30</td><td>30</td></tr>
<tr><td colspan="3">Average of 3 tests – 15 Marks</td></tr>
<tr><td colspan="3">AAT – 10 Marks</td></tr>
<tr><td>Practical</td><td colspan="3">Weekly assessment -10Marks
IA test - 15Marks</td></tr>
<tr><td></td><td colspan="3">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B. N. M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Natural Language Processing **Course Code: 24CSE154**

L: T: P: J	**3:0:2:0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/Week (Total)	**50**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Learn the techniques in natural language processing.
2	Be familiar with the natural language generation
3	Be exposed to text mining
4	Understand the information retrieval techniques.

Module-1: Word – Level Analysis	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction: What is Natural Language Processing (NLP), Origins of NLP, Phases of NLP, The Challenges of NLP- Why is NLP hard? Language and Grammar, Applications of NLP, Introduction to the corpus. **Word level Analysis:** Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction. Part-of-Speech Tagging- Rule based tagger, Stochastic tagger, Hybrid Taggers, Handling unknown words during POS Tagging. **Self-Study Component**: Corpus, Basic elements of corpus, Regular Expressions-Finite-State Automata **Practical:** 1. Python code to implement Tokenization and Removal of Stop words 2. Hands-on session on stemming and lemmatization with examples using spaCy/NLTK 3. Corpus- Design a Python program to illustrate corpus. 4. Process-Implement a python program to process the given text. 5. POS Tagger- Design python program to perform part-of-speech tagging on the text scraped from a website.	10	L3 (Apply)
Module-2: N-Gram Model and Syntax Parsing		
Language Modelling: Types of language models, Statistical Language Model: N-grams, Training, Evaluating Statistical language model, Test Sets Perplexity, Sampling sentences from a language model, Simple N-grams, Smoothing- Add-one smoothing, Laplace smoothing, Good Turing smoothing. Constituency Parsing: Constituency, Context-Free Grammars, Treebanks, Ambiguity, CKY Parsing: A Dynamic Programming Approach. Dependency Parsing: Dependency Relations, Transition-Based Dependency Parsing, Graph	10	L3 (Apply)

Based Dependency Parsing. **Self-Study Component:** Advance issues in Good Turing discounting estimation. **Practical:** 1. Python code to implement N-gram model. 2. Smoothing-Design a Python program to perform smoothing using various methods in Python. 3. Good T uring- Develop a Python program to calculate good Turing frequency. **4.** Python code to generate a dependency parse tree for any English sentence 5. Python code to generate a Constituency parse tree for any English sentence		
Module-3: Lexical Semantics		
Meaning Representation, Lexical Semantics-Relationships, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the TF-IDF or PPMI vector models, Word2vec, Visualizing Embeddings, Word Sense Disambiguation, context-based word sense disambiguation, Approaches-Lesk's Algorithm, Knowledge source in WSD. **Self-Study Component:** Context-based word sense disambiguation Approaches- KNN algorithm & Bayesian Classification. **Practical:** 1. Lexical Semantics- Design Python program to do text classification. 2. Implementing TF-IDF for Text Vectorization in NLP. 3. Python code to calculate vector similarity in semantic space. 4. Python code to identify the context for ambiguous words using Contextual Word Embeddings using BERT 5. Disambiguity- Design the Lesk algorithm in Python to handle word sense disambiguation.	10	L4 (Analyze)
Module-4: Information Retrieval		
Information Retrieval-Introduction, Design features of information retrieval systems- Indexing, eliminating stop words, Stemming, Classical information retrieval Models- Boolean model, Probabilistic model, Vector space model. **Applications:** Information Extraction, Automatic text summarization: Types of Summaries & Approaches, Question –Answer System: Architecture of an Open-Domain Question-Answering System. **Self-Study Component:** Topic Modelling. **Practical:** 1. Information Extraction- Design Python programs to extract structured information from unstructured information. 2. Question Answering System- Design a questioning answer system using Python. 3. Design and Implementation of an Information Retrieval System with Indexing, Stop-word Removal, and Stemming in Python.	10	L4 (Analyze)
Module-5: Large Language Models		

Introduction to NLP pre trained Language Models: Drawback of RNN and LSTM. Transformer-based language models, GPT, BERT, RoBERTa, ALBERT, ELECTRA, XLNet, T5, Transformers Model, Attention Mechanism, Positional Encoding, Analysis of Generated Text - Temperature parameter, Attention score for generated words. **Self-Study Component**: Overview of other large language models for different NLP tasks: BERT, T5, GPT-3, GPT-4, ChatGPT. **Practical:** 1. Positional Encoding-Implement a python code to do positional encoding in GPT **2.** Coreference Resolution with Pretrained Transformers 3. Develop a simple chatbot using Chatgpt-2/GPT-3.	10	L4 (Analyze)

COs	Statement	Bloom's Cognitive level	POs/PSOs
24CSE154.1	Identify the challenges of NLP and POS – Tagging Techniques	L3 (Apply)	PO1, PO2, PO3, PO4, PO5, PSO2
24CSE154.2	Develop Statistical Modelling and Syntax Parser	L3 (Apply)	PO1, PO2, PO3, PO4, PO5, PSO2
24CSE154.3	Discover the semantic relationships between the words in the sentence	L4 (Analyse)	PO1, PO2, PO3, PO4, PO5, PSO2
24CSE154.4	Analyse Information Extraction Models in NLP	L4 (Analyse)	PO1, PO2, PO3, PO4, PO5, PSO2
24CSE154.5	Analyse the applications of Large Language Models.	L4 (Analyse)	PO1, PO2, PO3, PO4, PO5, PSO2

Text Books

1. Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, 1st Edition Oxford University press, 2008
2. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky, James H Martin, 3rd Edition, Prentice Hall, 2024.
3. Natural Language Processing: An Information Access Perspective, Kavi Narayana Murthy, Ess Ess Publications, 2006.

Reference Books

1. David Foster. Transformers, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, Second Edition, O'Reilly, 2023.
2. Applied Text Analysis with Python, Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, O'Reilly Media, 2018.

Marks Distribution for Assessment

<table>
<tr><th rowspan="2">PCI</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="3">CIA (50)</th><th colspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><td></td><td>I</td><td>II</td><td>PART A</td><td>PART B</td></tr>
<tr><td rowspan="3">Conduction</td><td rowspan="3">50</td><td rowspan="3">50</td><td rowspan="2">IA Test</td><td>30</td><td>30</td><td rowspan="2">30 Marks</td><td rowspan="2">70 Marks</td></tr>
<tr><td colspan="2">Average of two tests – 30 M</td></tr>
<tr><td>Continuous Assessment</td><td colspan="2">Weekly Assessment -20 marks</td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td colspan="2">Total – 50 Marks</td></tr>
</table>

B. N. M. Institute of Technology

An Autonomous Institute Under VTU
Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: V

Course Name: Cloud Computing and Applications		**Course Code: 24CSE155**
L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	Understand the basics of Cloud Computing.
2	Obtain an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
3	Develop programs and do experiment with the various cloud computing environments.
4	Develop applications with the help of cloud infrastructure

Module-1: Introduction to Cloud Computing	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to Cloud, Historical Development of Cloud, Building Cloud Computing Environments, Properties - Characteristics, Cloud issues and challenges – Cloud Computing Platform and Technologies, Virtualization Concepts- Characteristics, Taxonomy of Virtualization Techniques, Hypervisors, Types of Virtualization, Pros and Cons of Virtualizations.	**8**	**Understand CO1**
Module-2: Cloud Computing Architectures		
Cloud Reference Models- Architecture, Service Models- IAAS,PAAS,SAAS, Types of Clouds- Public, Private, Hybrid, Community, Open Challenges, Key drivers to adopting to Cloud, Barriers to Cloud Computing in Enterprises	**8**	**Apply CO2**
Module-3: Migrating into a Cloud		
Introduction, Challenges while migrating to Cloud, Broad approaches to migrating into the cloud why migrate -deciding on cloud migration, the Seven-step model of migration into a cloud, Migration Risks and Mitigation, relevant Deployment Models for Enterprise Cloud Computing.	**8**	**Apply CO3**
Module-4: Cloud Programming and Software Environments		
Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms – Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine	**8**	**Apply CO4**
Module-5: Introduction to GIT and Docker		
Introduction: What is Git? What is Git History? Why Use It? Where to use Git? Key Git Concepts: Repository, Clone, Stage, Commit, Branch, Merge, Pull, Push. Introduction to CI/CD, Introduction to Docker, Key Components of Docker, Docker file, Docker Architecture and its working, Docker Image, Docker Container, Docker Hub, Docker Commands.	**8**	**Apply CO5**

Laboratory Component

1. a. Install Virtual box/VMware Workstation with different flavors of Linuxor Windows OS on top of windows.

b. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs.

2. To set up an AWS account and explore the services offered by AWS
3. Exploring AWS Cloudshell Environment.
4. Working with Amazon S3, Orchestrating Serverless function with AWS step functions.
5. Working with Amazon DynamoDB.
6. Creating a Lambda functions using AWS SDK for python.
7. Creating a GIT repository and executing the control system commands to Clone, Commit, Push, Fetch, Pull, Checkout, Reset and Delete.
8. Automating Application deployment using CI/CD pipeline.
9. Migrating Web Application to Docker Containers.
10. Build a Docker Image from a Simple Application

Course Outcomes: After completing the course, the students will be able to	
24CSE155.1	Describe various cloud computing platforms, virtualization techniques and deployment models along with its advantages and dis-advantages.
24CSE155.2	Identify the role of different service models in Cloud platform.
24CSE155.3	Identify various methods to migrate into cloud & its associated challenges.
24CSE155.4	Make use of the appropriate cloud programming paradigms and computing solutions.
24CSE155.5	Identify the methods to manage code and environment using GIT and Docker.

Text Books

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012.
2. Rajkumar Buyya, " Mastering Cloud Computing" McGraw Hill, 2013.
3. Rajkumar Buyya, " Cloud Computing: Principles and Paradigms", John Wiley & Sons, 2010.

Reference Books

1. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance", O'Reilly 2009.
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Theory Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 15 Marks	15
		AAT – 10 Marks	10
	Practical	Weekly Assessment – 10 Marks	10
		IA Test – 15 Marks	15
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
Total marks for the Course			**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Operating System		**Course Code:** 24CSE1561
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Introduce concepts and terminology used in OS
2	Explain threading and multithreaded systems
3	Illustrate process synchronization and concept of Deadlock
4	Introduce to Unix File Systems

Module-1: Introduction to Operating System& Process Management	**No. of Hours**	**Blooms cognitive levels with CO mapping**
Fundamental Concepts of Operating System: Introduction to Operating systems, Operating system functions and services. **Process Management:** Process abstraction, process address space, process management, system calls, threads. **CPU Scheduling:** Levels of scheduling, comparative study of scheduling algorithms, Multilevel Queue Scheduling, Multi- processor scheduling.	**8**	**Apply CO1**
Module-2: Process Synchronization and Deadlocks		
Concurrent Processes: Critical section problem, Semaphores, Classical problems of synchronization, monitors, inter-process communication, message passing mechanisms. **Deadlocks:** Characterization, prevention and avoidance, deadlock detection and recovery.	**8**	**Apply CO2**
Module-3: Memory Management		
Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation, Demand paging, page replacement algorithms, thrashing, Disk Scheduling.	**8**	**Apply CO3**
Module-4: Unix files System		
Unix files: UNIX Architecture, Naming files, Basic file types/categories, Organization of files, Hidden files, Standard directories. Parent child relationship. The home directory and the HOME variable. Reaching required files- the PATH variable, manipulating the PATH, Relative and absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative pathnames. File related commands – cat, mv, rm, cp, wc and od commands. **Practical component**: Execution of UNIX Shell Commands.	**8**	**Apply CO4**
Module-5: File attributes and permissions		
File attributes and permissions: The ls command with options. Changing file permissions: the relative and absolute permissions changing methods. Recursively changing file permissions. Directory permissions. The shells interpretive cycle: Wild cards. Removing the special meanings of wild cards. Three standard files and redirection. **Connecting commands:** Pipe, grep, egrep.	**8**	**Apply CO5**

Shell programming: Ordinary and environment variables. Read and read-only commands. Command line arguments. exit and exit status of a command. Logical operators for conditional execution. The test command and its shortcut. The if, while, for and case control statements. Simple shell program examples. **Practical component:** Execution of Wildcards & UNIX Shell Programs.		

Course Outcomes: After completing the course, the students will be able to	
24CSE1561.1	Apply the concepts of process scheduling to improve CPU utilization and identify various multi- threading models
24CSE1561.2	Identify the need of policies, protection required in managing deadlock, main and virtual memory & various techniques in managing concurrent processes
24CSE1561.3	Apply the concept of paging & segmentation for effective memory management
24CSE1561.4	Apply the concepts of Unix system and file commands to perform various tasks in files and system.
24CSE1561.5	Apply the concepts of Wildcards and Shell Programming to write basic shell scripts and formulating regular expressions for Pattern matching

Text Books
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006 2. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill.
Reference Books
1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 9th Edition 2018. 2. W. Richard Stevens: Advanced Programming in the UNIX Environment, 2nd Edition, Pearson Education, 2005 3. Unix System Programming Using C++ - Terrence Chan, PHI, 1999.

Marks Distribution for Assessment:

CIA	Component	Description	Marks
50	Written Test	• Total Number of Test: 3 • Each Theory test will be conducted for 30 marks • Average of 3 tests = 30 Marks	30
	Assignment	Assignments on Shell scripts & UNIX Commands	10
	AAT	Case study & Implementation of Algorithms in Operating Systems	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Object Oriented Programming Using Java		**Course Code:** 24CSE1562
L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the fundamental principles of object-oriented programming using Java.
2	Develop Java applications using classes, objects, arrays, and strings.
3	Implement inheritance, interfaces, and handle exceptions effectively.
4	Apply multithreading and perform I/O operations in Java.
5	Use Java Collections framework and perform database connectivity using JDBC.

Module-1: Introduction to Java	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction to Java: Features of OOP, Characteristics/Buzz words of Java, Java Environment: JDK, JVM, JRE, Fundamental Programming Structure in Java, Variables, Data Types, Operators & Expressions, Control Statements, Iteration Statements, Command Line Arguments. Single and Multidimensional Arrays. **Practical Component:** 1. Write a program to implement a simple ATM system where: a. A menu-driven interface is provided using switch statement b. The user can withdraw, deposit, or check balance c. Use while loop to keep the session active until the user exits 2. Develop a Java program that accepts employee details (name, age, department) as command line arguments and displays them in a formatted output. Validate inputs (e.g., age must be numeric and > 18).	**8**	**Apply CO1**
Module-2: Classes & Objects		
Classes & Objects: Defining Classes & Objects, Access Specifies, Constructors, Overloading Constructor, Method Overloading, Passing and Returning object form Method, new operator, finalize() method, this keyword, Static Keyword, Encapsulation, Polymorphism. **Strings:** Definition of String, String Literals, String Class, String Inbuilt Methods, StringBuffer & StringBuilder Class. **Practical Component:** 1. Design a class Student with private fields: name, rollNo, and marks. a. Use constructor overloading to allow both default and parameterized object creation. b. Apply encapsulation using getters and setters. c. Use the this keyword to resolve variable shadowing. d. Track total students using a static variable and method. e. Create another method that accepts a Student object as parameter and returns the same object with bonus marks added. 2. Create an abstract base class Shape with an abstract method area(). a. Derive classes Circle, Rectangle, and Triangle that override area() method using runtime polymorphism. b. Demonstrate calling overridden methods using a base class reference.	**8**	**Apply CO2**

Module-3: IO Programming & Files		
IO Programming: Introduction to Stream, Byte Stream, Character stream, Readers and Writers, File Class, File InputStream, File Output Stream, InputStreamReader. **Inheritance:** Defining a Inheritance, Types of Inheritance, Constructor in subclass, Method Overriding, super keyword, abstract keyword, final keyword. **Practical Component:** 1. Create an Employee class with fields: id, name, and salary. a. Use FileOutputStream and FileInputStream to write and read employee details from a file in byte stream format. b. Use the File class to check if the file exists or create a new one. c. Apply constructor in subclass by extending Employee to Manager with additional field department. 2. Design an abstract class Test with an abstract method generateResult(). a. Extend it with OnlineTest and OfflineTest classes. b. Use FileReader to read marks from a file and override the generateResult() method to calculate grade. c. Mark the generateResult() method as final in one subclass to restrict overriding.	**8**	**Apply CO3**
Module-4: Interfaces, Packages & Exceptions		
Interfaces & Packages: Defining a Interface, Implementing a Interface, Difference between Interface & Classes, Extending a Interface, Usage of Package, Classpath, Importing a Package. **Exceptions:** Definition of Exception, Classification of Exception, Structure of Try & catch block, Error Vs Exception, Throw Keyword, Throws Keyword, Finally Keyword, Custom Exception. **Practical Component:** 1. Create an interface PersonDetails with method display(). Extend it in another interface StaffDetails with method calculateSalary(). a. Implement StaffDetails in a class Professor. b. Simulate error scenarios like null values or negative salary using throw and throws keywords. c. Use a package university.staff and demonstrate use of classpath and import statements in a driver class. 2. Design a package student.registration with a class Student and interface Registrable. a. The interface should declare a method register(). b. Implement the interface and throw a custom exception InvalidRegistrationException if age is below 18. c. Use try-catch block and a finally block to confirm registration closure.	**8**	**Apply CO4**
Module-5: Multithreading & Enumerations		
Multithreading: Multi-Threaded Programming: What are threads? How to make the classes threadable? Extending threads, Implementing runnable, Synchronization, Thread priorities. Enumerations (Enumeration Fundamentals, The values() and valueOf() Methods), Type Wrappers, The values() and valueOf() Methods, Type Wrappers, Autoboxing. **Practical Component:** 1. Design a class TicketCounter where multiple users (threads) try to book tickets simultaneously. a. Use thread synchronization to prevent race conditions.	**8**	**Apply CO5**

b. Create user threads by both extending Thread and implementing Runnable. c. Assign thread priorities based on user type (e.g., VIP, Regular). d. Use an enum UserType { VIP, REGULAR } to distinguish users and use valueOf() to convert string input. 2. Create a class BankAccount that supports deposit and withdrawal. a. Spawn multiple threads to simulate transactions concurrently using Runnable. b. Ensure thread synchronization for consistency. c. Use enum TransactionType { DEPOSIT, WITHDRAW } and demonstrate values() and valueOf() methods. d. Show how thread priority affects execution order (optional based on thread scheduler).		

Course Outcomes: After completing the course, the students will be able to	
24CSE1562.1	Understand object-oriented programming concepts and basics of JAVA to solve simple problems.
24CSE1562.2	Construct a class involving data members and methods for the given scenario.
24CSE1562.3	Apply the concepts of inheritance and Java I/O streams to implement Java applications
24CSE1562.4	Apply the concepts of packages, interfaces and exception handling.
24CSE1562.5	Develop Java applications using multithreading, enumerations and wrapper clases.

Text Books

1. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, - TMH.
2. Java Fundamentals A comprehensive introduction By Herbert Schildt, Dale Skrien, McGraw Hill Education.
3. Programming with Java A Primer – E.Balaguruswamy,Mc Grawhill.

Reference Books

1. Core Java Volume-I Fundamentals Horstmann & Cornell, - Pearson Education. - Eight Edition
2. Head First Java: A Brain-Friendly Guide, 2nd Edition- Kathy Sierra, Bert Bates.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	AAT	Presentation/Assignments	20
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V (Open Elective – 1)

Course Name: Efficient Algorithms and Data Structures using Java **Course Code:** 24CSE1563

L:T:P:J	**2:0:2:0**	**CIA Marks:**50
Credits:	**3**	**SEA Marks:**50
Hours/Week (Total)	**40**	**SEA Duration:**03Hours

Pre-Requisites: Basics of Mathematical and Statistical Methods, Object Oriented Programming, familiarity and program writing skills in Java

Course Learning Objectives: The students will be able to

1	Master fundamental and advanced data structures and algorithmic techniques in Java.
2	Analyze and optimize the time and space complexity of code for high-performance computing
3	Implement classical algorithms and understand their real-world applications in software development.
4	Build scalable and efficient systems by choosing appropriate data structures and patterns.
5	Practice competitive coding and problem-solving through hands-on labs and challenges.

Module	No. of Hours	Blooms Cognitive Levels with CO mapping
Module-1: Introduction to Algorithmic Thinking and Java Foundations		
This module begins by building a strong foundation in algorithmic problem-solving and Java syntax essentials. Students will understand time and space complexity, asymptotic analysis (Big-O, Big-Theta, Big-Omega), and dive into recursion, iterative logic, and debugging strategies. Basic I/O handling, array and string manipulation, and Java's memory model are also covered to create a solid platform for more complex concepts. Self-study: Practice basic problems on arrays, strings, and recursion using platforms like LeetCode or HackerRank.	8	Apply
Module-2: Linear and Non-linear Data Structures		
Learners will explore the implementation and application of arrays, linked lists, stacks, queues, hash tables, and heaps in Java. They'll understand how to use Java's Collections Framework and when to build custom implementations for optimization. This module also introduces trees and graphs — starting with binary trees, BSTs, heaps, and progressing to traversal algorithms, adjacency lists, and graph representations in code. Self-study: Implement custom versions of these data structures and solve use-case specific problems (e.g., LRU cache, job scheduling).	8	Apply
Module-3: Algorithm Design Techniques		

This module delves into the core algorithmic paradigms including divide and conquer, greedy methods, dynamic programming, and backtracking. Through in-depth examples such as merge sort, activity selection, longest common subsequence, and the N-Queens problem, students will learn how to recognize patterns and design efficient solutions. Java-specific best practices like memorization via HashMap and bottom-up tabulation strategies are integrated into each technique. Self-study: Solve classical algorithm problems from previous coding competitions, optimizing for both clarity and performance.	8	Apply
Module-4: Advanced Algorithms and Applications		
In this module, students engage with complex topics such as trie structures, segment trees, disjoint sets (Union-Find), and shortest path algorithms like Dijkstra's and Floyd-Warshall. Real-world applications such as autocomplete systems, range queries, social network analysis, and route optimization are explored. Students will also learn string algorithms like Rabin-Karp and KMP for efficient pattern matching. Self-study: Research case studies where these algorithms have been used in large-scale systems (e.g., Google Maps, search engines).	8	Apply
Module-5: Problem Solving, Optimization, and Interview Preparation		
The final module focuses on competitive programming techniques and real-world problem solving. Learners will be exposed to constraints-driven optimization, bit manipulation, sliding window, two-pointer techniques, and combinatorics. The module ends with mock interviews, algorithmic system design questions, and performance tuning of Java code. Emphasis will be placed on writing clean, testable, and modular code under time constraints. Self-study: Participate in weekly contests, review past interview questions, and prepare a GitHub repository of solved problems with clean documentation.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
24CSE1563.1	Understand the advancements of Algorithms
24CSE1563.2	Apply object-oriented programming concepts and to develop applications
24CSE1563.3	Make use of inheritance, interface, and package to solve problems.
24CSE1563.4	Apply multithreading and IO Programming concept to solve real time concurrent applications.
24CSE1563.5	Apply Exception and Collections to develop applications.

Text Books

1. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, - TMH.
2. Java Fundamentals A comprehensive introduction By Herbert Schildt, Dale Skrien, McGraw Hill Education.
3. Programming with Java A Primer – E.Balaguruswamy, Mc Grawhill

Reference Books

1 Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.

2 Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Open ended experiments	10
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science & Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: V

Course Name: Database Management System **Course Code:** 24CSE1564

L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand fundamental concepts, terminology and application of databases, SQL and NoSQL
2	Design concepts and creation of relational databases using relation algebra.
3	Practice SQL programming through a variety of database problems.
4	Demonstrate the use of Normalization, concurrency and transactions in database.

Module-1: Database System Concepts, Data Modeling	**No. of Hours**	**Blooms cognitive Levels**
Databases and Databases Users: Characteristics of database Approach, Advantages of using the DBMS Approach. Database System Concepts and Architecture: Data Models-Schemas, Three-Schema Architecture and Data Independence, Database Languages Data Modeling Using the Entity-Relationship (ER) Model: Entity Types-Entity sets- Attributes and Keys, Relationship types, structural Constraints, Weak Entity Types.	**8**	**Understand CO1**
Module-2: Relational Data Model and Relational Algebra		
Concepts of relations, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, various types of joins, division, example queries	**8**	**Apply CO2**
Module-3: SQL		
Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT – DELETE and UPDATE Statements in SQL, Additional features in SQL. **More SQL:** Specifying Constraints as Assertions and actions as Triggers, Views (Virtual Tables) in SQL.	**8**	**Apply CO3**
Module-4: Functional Dependencies and Normalization		
Basics of Functional Dependencies and Normalization for Relational Database: Functional Dependencies, Equivalent Decompositions, closure of a set of FDs, minimal covers, Normal forms Based on Primary Keys, General Definitions of Second and Third Normal Forms.	**8**	**Analyze CO4**
Module-5: Transaction Processing, Concurrency Control, NoSQL		
Introduction to Transaction Processing –Introduction to Transaction Processing, Desirable Properties on Transactions (ACID) **Concurrency Control Techniques:** Transactions and Schedules, Serializability, Precedence Graphs, Concurrency, Lock Based Protocols: 2PL, Strict 2PL Protocols.	**8**	**Analyze CO5**

Practical Component:

1. Draw ER Diagram for the following Databases using GitMind software.
A) Order Database b) Library Database.

2. Create Schema, insert at least 5 records for each table and add appropriate constraints for the following Order Database using ORACLE or MySQL DBMS under LINUX/Windows environment.

SALESMAN (Salesman_id, Name, City, Commission)
CUSTOMER (C_id, Cust_Name, City, Grade, Salesman_id)
ORDERS (Ord_No, Purchase_Amt, Ord_Date, C_id, S_id)

Write SQL queries to
1. Count the customers with grades above Bangalore's average.
2. Find the name and numbers of all salesmen who had more than onecustomer.
3. List all the salesman and indicate those who have and don't havecustomers in their cities (Use UNION operation.)
4. Create a view that finds the salesman who has the customer with the highest order.

3**.** Create Schema, insert at least 5 records in each table and add appropriate constraints for the following Library Database using ORACLE or MySQL DBMS under LINUX/Windows environment
BOOK (Book_id, Title, Publisher_Name, Pub_Year)
BOOK_AUTHORS (Book_id, Author_Name)
PUBLISHER (Name, Address, Phone)
BOOK_COPIES (Book_id, Branch_id, No-of_Copies)
BOOK_LENDING (Book_id, Br_id, Card_No, Date_Out, Due_Date)
LIBRARY_BRANCH (Branch_id, Branch_Name, Address)
Write SQL queries to
1. Retrieve details of all books in the library – id, title, name of publisher,authors, number of copies in each branch, etc.
2. Get the particulars of borrowers who have borrowed more than 3 books,but from Jan 2020 to Jun 2022.
3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.

Course Outcomes: After completing the course, the students will be able to	
24CSE1564.1	Understand the Database System Concepts along with Data Modeling Using the Entity-Relationship (ER) Model
24CSE1564.2	Apply the concepts of relations on RDBMS, constraints, joints using relational algebra operators.
24CSE1564.3	Apply Structured Query Language for database manipulation.
24CSE1564.4	Analyze functional dependencies to normalize relations of relational database
24CSE1564.5	Analyze transactions processing, schedules protocols, serializability issues, deadlocks in DBMS and concepts of NoSQL with its advantages

Text Books

1. Ramez Elmasari, Shamkant B Navathe "Fundamentals of Database Systems", Pearson, Seventh Edition 2017.
2. "Database System Concepts", Silberschatz, H Korth, S Sudarshan, 6th Edition, McGraw-Hill, 2010
3. Pramod J Sadalage, Martin Fowler, "NOSQL Distilled", Pearson, 2013

Marks Distribution for Assessment:

CIA	Component	Description	Marks
50	Written Test	• Total Number of Test: 3 • Each Theory test will be conducted for 30 marks • Average of 3 tests = 30 Marks	30
	AAT	Case study/Assignment/Presentation	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Department of Computer Science and Engineering

VI Semester

Scheme of Teaching 2024 – 28 Batch

Sl. No.	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Hours Per Week	Credits	Examination		
					Lecture	Tutorial	Practical	Project					
					L	T	P	J			CIA	SEA	Total
1	PCC	24CSE161	System Software and Compiler Design	CSE	2	2	-	-	4	3	50	50	100
2	PCI-P	24CSE162	Cryptography and Cyber Security	CSE	3	-	2	-	5	4	50	50	100
3	PCI-C	24CSE163	Gen AI & Prompt Engineering	CSE	2	-	2	-	4	3	50	50	100
4	PBL	24CSE164	Data Science	CSE	1	-	-	2	3	2	50	50	100
5	PEC	24CSE165X	Professional Elective - I	CSE	2	2	-	-	4	3	50	50	100
6	PEC	24CSE166X	Professional Elective - II	CSE	2	-	2	-	4	3	50	50	100
7	PCC	24CSE167X	Open Elective - II	CSE	3	-	-	-	3	3	50	50	100
8	AEC	24CSE168	Employability Skills – I [Technical]	T&P	-	-	2	-	2	1	100	-	100
Total					15	4	8	2	29	22	450	350	800

Open Elective – II			
24CSE1671	Storage Area Networks	24CSE1672	Computer Graphics & Visualization
24CSE1673	Modern Web Development and UI/UX Design	24CSE1674	Machine Learning
24CSE1675	Technology and Transformation		
Professional Elective – I			
24CSE1651	Introduction to AI	24CSE1652	Information and Network Security
24CSE1653	Data Warehousing and Data Mining [Data Lake House]	24CSE1654	No Sql Database
24CSE1655	Cryptography and Hash Integrity Protection	24CSE1656	Advanced Computer Architecture
Professional Elective – II			
24CSE1661	Digital Image Processing	24CSE1662	Reverse Engineering & Malware Analysis
24CSE1663	DevOps	24CSE1664	Augmented Reality & Virtual Reality
24CSE1665	Cyber Security & Digital Forensics	24CSE1666	High Performance & Computer Architecture

CIE: Continuous Internal Evaluation, SEE: Semester End Examination, NCMC: Non Credit Mandatory Course AICTE Activity Points to be earned by students admitted to BE day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other institutions and Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to BNMIT. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

BSC → Basic Science	PW → Project Work	MAT → Mathematics	PEC → Professional Elective	INT → Internship
PBL → Project Based Learning	OEC → Open Elective	HUM → Humanities and Social Science	PCC → Professional Core Course	PCI → Professional Core Course Integrated
AEC → Ability Enhancement Course	UHV → Universal Human Values			

Head of the Department
Dept. of Computer Science & Engineering
BNM Institute of Technology
Bangalore - 560 070

23/08

Additional Director & Principal
BNM Institute of Technology
Bangalore-560 070

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: VI

Course Name: System Software and Compiler Design **Course Code: 24CSE161**

L: T: P: J	**2:2:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4 (40)**	**SEA Duration:** 03 Hours

Pre-Requisites: The concepts of Finite State Machines, Regular Expressions, Context Free Grammars

Course Learning Objectives: The students will be able to

1	Understand the various system softwares by learning their working techniques
2	Familiarize with source file, object file and executable file structures and libraries
3	Describe the front-end and back-end phases of compiler and their importance to students
4	Apply SDT and describe various IR techniques
5	Describe the various code optimization techniques employed by the compiler

Module-1 : System Software	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction to System Software, Machine Architecture of SIC and SIC/XE. Assemblers: Basic assembler functions, machine dependent assembler features, Basic loader functions	**8 hours**	**Apply CO1**
Module-2: Introduction & Lexical Analysis		
Introduction: Language Processors, The structure of a compiler, Applications of compiler technology, **Lexical Analysis:** The role of lexical analyzer, Input buffering, Specifications of token, recognition of tokens	**8 hours**	**Apply CO2**
Module-3: Syntax Analysis		
Introduction, Role Of Parsers, Context Free Grammars, Writing a grammar, Derivation, Ambiguity, Left Recursion, Top Down Parsers, Bottom-Up Parsers: Shift Reduce Parser, Simple LR and Canonical LR	**8 hours**	**Apply CO3**
Module-4: Semantic Analysis		
Syntax directed translation: Syntax directed definitions, Evaluation orders for SDD, Applications of syntax directed translations **Intermediate code Generation** : Variants of syntax trees, three-address code ,type declarations, type checking, IR for switch statements and procedures	**8 hours**	**Analyze CO4**
Module-5: Target Code Generator		
Issues in the Design of a Code Generator, The target Language, Addresses in the target code, Basic blocks and Flow graphs, Optimization of basic blocks, A simple code generator.	**8 hours**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE161.1	Apply the concepts and algorithms for design system softwares like assemblers, linkers and loaders.
24CSE161.2	Apply the concepts of lexical analysis for token recognition and token specification.
24CSE161.3	Apply the parsing techniques and grammar transformation techniques for Syntax analysis.
24CSE161.4	Analyze Syntax directed Translations, Intermediate Representation for generating target code.
24CSE161.5	Apply algorithms that code generators utilize to translate the IR into a sequence of target language instructions for simple register machines and generate optimal codes

Text Books
1. System Software by Leland. L. Beck, D Manjula, 3rd edition, 2012 2. Compilers-Principles, Techniques and Tools by Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman. Pearson, 2nd edition, 2007
Reference Books
1. Systems programming – Srimanta Pal , Oxford university press, 2016 2. System programming and Compiler Design, K C Louden, Cengage Learning 3. System software and operating system by D. M. Dhamdhere TMG 4. Compiler Design, K Muneeswaran, Oxford University Press 2013.

Marks

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Presentation / Demonstration of mini project	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: 6

Course Name: Cryptography and Cyber Security **Course Code:** 24CSE162

L: T: P: J	**3: 0: 2: 0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/Week (Total)	**50**	**SEA Duration:** 03 Hours

Pre-Requisites: Nil

Course Learning Objectives: The students will be able to

1	Enable to learn the fundamental concepts of cryptography, and steganography and make use of these techniques in computing systems.
2	Choose between symmetric and asymmetric encryption techniques depending on the application.
3	Summarize the policies and laws in cyber security.
4	Analyze the security issues and risks in Computer Networks.
5	Analyze the security issues and risks in software and web.

Module-1:	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Classical Ciphers: Introduction to cryptography, cryptanalysis, and cryptology, Overview of cryptography, Basic Cryptographic primitives, Classical ciphers: substitution cipher – Caesar, Playfair and Hill cipher, Transposition cipher – Rail fence, Columnar and Double columnar, One-time-pad encryption, Limitations of One-Time-Pad, Steganography. ***Laboratory Component:*** 1. Make use of Steganographic tools to hide text in an image. 2. Make use of Steganographic tools to hide an image in an image.	6 4	Apply CO1
Module-2:		
Modern Cryptography: Modern cryptography: Perfectly secret encryption, Symmetric Key Ciphers: AES, Asymmetric Key Ciphers-Key distribution and Key Management, Diffie Hellman Protocol, RSA Encryption, Digital Signature, Cryptanalysis ***Laboratory Component:*** 1. Installing openssl package 2. Execute openssl commands for AES encryption and decryption with image and text as input. 3. Write a simple program to find a key from a wordlist, given a plaintext, an IV, and the corresponding ciphertext.	6 4	Apply CO2
Module-3:		
What is cyber security? Need for cyber security, data privacy, Risk Management, Digital Forensics- Incident response, Security operations. The legal perspectives: Cyber-crime and legal landscape around the world, Why do we need cyber laws: The Indian context ***Laboratory Component:*** 1. Installation of Wire shark, tcpdump 2. Capturing and analyzing packets	6 4	Apply CO3
Module-4:		
Network Security: Wired Security Issues: Firewalls, Intrusion Detection, Intrusion Prevention Systems, Honeypots, DoS and DDOS attack, Wireless Security issues- Android and iOS Security, App Security, Secure Boot, Data Exfiltration, Wireless Protected Access (WPA), IEEE 802.1x,	6	Analyze CO4

802.11i/ WPA2, Wireless Network Threats, Cloud and IoT Application Security ***Laboratory Component:*** 1. Use of scapy tool for DOS attack 2. Nmap and nc commands	4	
Module-5:		
Software and Web Security: Operating system security: Attack Surfaces of Set-UID Programs, Principle of Least Privilege; Environment variables attack surface, Control Hijacking– Buffer overflow and Countermeasures, Web security: Cross-Site Request Forgery, Cross-Site Scripting, SQL Injection, Threat Modelling- design, Types of Security testing: Fuzz testing, Vulnerability scanning, Penetration Testing; Static and Dynamic analysis. ***Laboratory Component:*** 1. SQL injection attack	6 4	Analyze CO5

Course Outcomes: After completing the course, the students will be able to	
25CSE162.1	Make use of steganography to hide data.
25CSE162.2	Choose appropriate private or public key encryption techniques depending on the application.
25CSE162.3	Summarize the policies and laws in cyber security.
25CSE162.4	Analyze the security issues and risks in Computer Networks.
25CSE162.5	Analyze the security issues and risks in software

Textbooks

1. **"Introduction to Modern Cryptography",** Jonathan Katz, Yehuda Lindell, 2nd Edition, CRC Press, 2015.
2. Wenliang Du,Computer Security A Hands-on Approach,2017

Reference Books

1. **"Cryptography and Network Security"** Behrouz A.Foruzan, 3rd Edition, Tata McGraw Hill, 2017
2. William Stallings, Lawrie Brown, "Computer Security: Principles and Practice", Indian Edition,Pearson, 2010.
3. Jonathan Rosenoer,"Cyber Law: The law of the Internet", Springer-Verlag, 1997.
4. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.

Marks Distribution for Assessment

<table>
<tr><th rowspan="2">PCI</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="3">CIA (50)</th><th colspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><td></td><td>I</td><td>II</td><td>PART A</td><td>PART B</td></tr>
<tr><td rowspan="4">Conduction</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="2">IA Test</td><td>30</td><td>30</td><td rowspan="2">30 Marks</td><td rowspan="2">70 Marks</td></tr>
<tr><td colspan="2">Average of two tests – 30 M</td></tr>
<tr><td>Continuous Assessment</td><td colspan="2">Weekly Assessment -20 marks</td></tr>
<tr><td colspan="3">Total – 50 Marks</td><td colspan="2">Total – 50 Marks</td></tr>
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B. N. M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: VI

Course Name: Gen AI & Prompt Engineering **Course Code: 24CSE163**

L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 3 Hours

Course Learning Objectives: The students will be able to

1	Be familiar with the natural language generation.
2	Understand the key components in transformers architectures and its role in language generation.
3	Enhance the Large Language Model (LLM) performance through human interaction.
4	Understand the concepts and principles of prompt engineering in AI, focusing on natural language processing (NLP) and large language models (LLMs).

Module-1: Introduction to GenAI	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to GenAI: Deep Learning vs GenAI, Discriminative AI vs Generative AI, Applications of GenAI, Transformer Architecture, why are transformers models trending?, Attention mechanism, Decoder only models, Encoder only models, Encoder and Decoder models, Examples. **Sample Programs**: - 1. Develop a simple Transformer for Text Classification using HuggingFace 2. Develop a python code to illustrate attention mechanism visualization.	8	L3 (Apply)
Module-2: Text-to-Image Models		
Types of Generative AI, text-to-image models like DALL-E, Stable Diffusion, and MidJourney. Fine-tuning large pre-trained generative models, Introduction to GANs, Types of GANs, working principles of GAN architecture, Instruction tuned and Fine-tuned models, Lang chain framework. **Sample Programs**: - 1. Implement a DeepFake applications using GAN 2. Implement Diffusion Models for image generation using tools like HuggingFace Diffusion library.	8	L3 (Apply)
Module-3: Large Language Models (LLM)		
Introduction to LLM, LLM's characteristics, Fine Tuning LLMs, Top-k vs Top-p Sampling, Temperature-Impact of Probabilities distribution, Variational Autoencoders (VAEs) with a focus on large language models (LLMs), Introduction to GPT-4, Comparison of GPT 4 with their previous GPT model, PaLM, and LLaMA, Retrieval-augmented generation (RAG) frameworks, Vector Database. **Sample Programs: -** 1. Build a text generation model using HuggingFace Transformers and a pretrained GPT model. **2.** Experiment with GPT-based summarization or Q&A	8	L4 (Analyze)
Module-4: GenAI project Life Cycle		

GenAI project Life Cycle, Parameter Efficient Fine Tuning (PEFT), Introduction to Prompting: - What is Prompting? - Importance in AI models, Prompt Formatting: - Defining the structure of a prompt - Role of clarity and precision - Common formatting practices, Prompt Elements: - Components of a good prompt, The Instruction, Context, and Desired Output, General Tips for Designing Prompts - Specificity and clarity - Avoiding impreciseness. **Sample Programs: -** 1. Implement using Python code to illustrate Parameter Efficient Fine-Tuning (PEFT) with LoRA using Hugging Face. 2. Python code to illustrate Prompt Engineering Basics (Prompting, Formatting, Best Practices)	8	L4 (Analyze)
Module-5: Advanced Prompting Strategies		
Zero-Shot Prompting & Few-Shot Prompting: - Definitions and differences - Examples and applications, Chain-of-Thought Prompting & Self-Consistency: - Enabling logical reasoning - Techniques to ensure consistent outputs, Generate Knowledge Prompting & Tree of Thoughts (ToT): - Fostering deep and comprehensive responses - Enhancing model creativity, Multimodal Chain-of-Thought (CoT) Prompting & Graph Prompting: - Handling multimodal inputs - Structuring prompts with graph logic. **Sample Programs: -** 1. Implement Zero-Shot vs Few-Shot Prompting 2. Implement the concept of Chain-of-Thought (CoT) Prompting with Self-Consistency	8	L4 (Analyze)

COs	**Statement**	**Bloom's Cognitive level**	POs/PSOs
24CSE163.1	Identify the Benefits of Transformer Architecture in GenAI	L3 (Apply)	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PSO2
24CSE163.2	Develop Applications using GAN and Diffusion Models	L3 (Apply)	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PSO2
24CSE163.3	Discover advantages of Fine-Tuning Large Language Models	L4 (Analyze)	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PSO2
24CSE163.4	Analyze how prompt-based learning influences AI model behavior and performance across various tasks	L4 (Analyze)	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PSO2
24CSE163.5	Analyze Generative AI Project Life Cycle and Advanced Prompting strategies.	L4 (Analyze)	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO12, PSO2

Text Books

1. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin
   - Covers fundamentals of NLP, including language modeling and syntactic analysis.
   - Topics: N-gram models, probabilistic models, context-free grammar.
2. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper
   - Focuses on practical NLP applications using Python (spaCy, NLTK).
   - Topics: Tokenization, stemming, lemmatization, syntactic parsing.
3. "Transformers for Natural Language Processing" by Denis Rothman
   - Explains transformer-based architectures like GPT, BERT, and fine-tuning models.
   - Topics: Text classification, embeddings, and transformers.
4. "Deep Learning for Natural Language Processing" by Palash Goyal, Sumit Pandey, and Karan Jain
   - Provides insights into deep learning techniques for NLP tasks.
   - Topics: Embeddings, generative models, and neural networks for NLP.
5. "The Art of Prompt Engineering with Chatgpt: A Hands-On Guide", by Nathan Hunter, Shroff Publishers and Distributors Pvt Ltd, 1st Edition, 2023.

Reference Books

1. **"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville**
   - A foundational book for understanding generative models, GANs, and deep learning.
   - Topics: Variational autoencoders, GANs, attention mechanisms.
2. **"Generative Deep Learning" by David Foster**
   - Explores concepts like GANs, VAEs, and diffusion models.
   - Topics: Generative AI applications, image generation, and text-to-image models.
3. **"Introduction to Information Retrieval" by Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze**
   - Detailed coverage of information retrieval and language modeling.
   - Topics: Statistical language models, search engine principles.

Online Study Resources and Tutorials

1. **NLP and Language Modeling**
   - "Introduction to NLP" (Stanford NLP Lecture): YouTube Video
   - "Understanding N-grams": Medium Article
2. **Transformer Models (GPT, BERT, T5)**
   - "Attention is All You Need Explained" (Jay Alammar): Visual Guide
   - "Fine-Tuning Pre-trained Models for NLP" (Hugging Face): Documentation
3. **Syntactic Analysis**
   - "Dependency Parsing with spaCy": Official Guide
   - "PCFG and CYK Parsing": Detailed Tutorial
4. **Generative AI and Applications**
   - "Introduction to Generative Models": YouTube Video
   - "Text-to-Image Models like DALL-E and Stable Diffusion": Hugging Face Guide

CO to PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
25CSE163.1	3	3	3	3	3	3		3						3
25CSE163.2	3	3	3	3	3	3		3						3
25CSE163.3	3	3	3	3	3	3		3						3
25CSE163.4	3	3	3	3	3	3		3	3	3				3
25CSE163.5	3	3	3	3	3	3		3				3		3

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCI-C</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th></th><th colspan="3">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 Marks
Reduced: 50 Marks</th></tr>
<tr><th></th><th>I</th><th>II</th><th>III</th></tr>
<tr><td rowspan="4"></td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="3">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests – 30 marks
(scaled down to 15 marks)</td></tr>
<tr><td>Activity</td><td colspan="3">10 Marks</td></tr>
<tr><td>Practical</td><td colspan="3">Weekly Assessment – 10 Marks
Lab IA Test – 15 Marks
(IA test to be conducted for 30 M and scaled down to 15M)</td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td colspan="4">Total – 50 Marks</td></tr>
</table>

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Data Science		**Course Code: 24CSE164**
L: T:P: J	**1:0:0:2**	**CIA Marks:**50
Credits:	**2**	**SEA Marks:**50
Hours/Week (Total)	**30**	**SEA Duration:**03Hours

Pre-Requisites: Linear Algebra, Probability and Statistics, Python Programming, Machine Learning Fundamentals, Problem-Solving and Critical Thinking

Course Learning Objectives: The students will be able to

1	Understand data science concepts
2	Learn a data analytics problem-solving framework
3	Apply the concepts of data science & solve real-life problems with different machine learning

Module-1:	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction to Data Science: Describing Data science, The data science Venn diagram, Python for Data Science, Data Science Case Studies. **Types of Data:** Structured versus unstructured data, quantitative versus qualitative data, the four levels of data: nominal, ordinal, interval and ratio. **The Data Science Process:** Overview, Defining research goals, Retrieving data, Cleansing, integrating and transforming data, exploratory data analysis, Build the models, Presenting findings. Data Analytics Lifecycle. Exercise: Case studies where Data Science is applied (e.g., fraud detection, recommendation systems).	**6**	**Understand CO 1**
Module-2:		
Statistics & Probability: Statistical Measures: Mean, median, mode, Variance and standard deviation, Correlation and covariance. Probability Theory, Probability Types, Probability Distribution Functions, Bayes' Theorem, Exercise: Spam Filter using Naïve Bayes	**6**	**Apply CO 2**
Module-3:		
Optimization for DS and ML: Elements of an Optimization Formation, Description of Stochastic Gradient Descent. **Regression Analysis:** Linear Regression: Simple Linear Regression, Multilinear Regression, Logistic Regression, Multinomial logistic regression, Receiver Operating Characteristic, Exercise: Apply different regression techniques using real-world datasets	**6**	**Apply CO 3**
Module-4:		
Dimensionality Reduction: Eigenvalues and Eigenvectors of Symmetric Matrices: Definitions, Computing Eigenvalues and Eigenvectors, Eigenvector matrix Principal-Component Analysis: Example, Using Eigenvectors for Dimensionality Reduction, The matrix of distances Singular-Value Decomposition: Definition, interpretation, Dimensionality Reduction Using SVD, Computing the SVD of a Matrix, Exercise: Perform PCA and SVD operations using NumPy, SciPy, and scikit-learn	**6**	**Apply CO 4**
Module-5:		
Classification Methods: Types of Classification Problems, Parametric Methods, Non-Parametric Methods. Future Directions. **Industry Use Cases:** Finance, Healthcare, Retail, Manufacturing. Project Management: Data science project lifecycle, Collaboration and communication, Ethical considerations and data privacy, Exercise: Understand different types of classification problems and explore real-world use cases in various industries.	**6**	**Create CO 5**

Course Outcomes: After completing the course, the students will be able to	
24CSE164.1	Summarize the fundamental concepts for Data Science.
24CSE164.2	Apply and visualize data for knowledge representation.
24CSE164.3	Apply Numerical Approaches to Solving Optimization Problems.
24CSE164.4	Build proficiency in data analysis.
24CSE164.5	Construct the classification methods of Data Science and conduct experiments to demonstrate the use of various data science tools .

Text Books

1. Raghunathan Rengaswamy, Reshmi Suresh, Data Science for Engineers, CRC Press, 2023.
2. Sinan Qzdemir, Sunil Kakade & Macro Tibaldeschi, Principles of Data Science, 2nd edition, Packt, 2018.
3. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, Fundamentals of Data Science, 1st edition, CRC Press, 2022.
4. Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science: Big Data, Machine Learning, and More, Manning, 2016.

Reference Books

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
2. Arshdeep Bahga, Vijay Madisetti, Big Data Science & Analytics – A Hands-on Approach, 1st edition, 2018.
3. Rachel Schutt, Cathy O'Neil, Doing Data Science, O'Reilly, 2014.
4. Jure Leskovec, Anand Rajaraman, Jeffrey D Ullman, Mining Massive Datasets, Dreamtech Press, 2016.

1. **Web Link:**
   https://books.google.co.in/books?id=NPGaEAAAQBAJ&newbks=0&printsec=frontcover&hl=en&redir_esc=y#v=onepage&q&f=false
2. **E-Book:**
   -Data Science & Machine Learning,
   https://people.smp.uq.edu.au/DirkKroese/DSML/DS
   ML.pdf
   -Foundations of Data Science (Swayam),
   https://onlinecourses.swayam2.ac.in/imb23_mg64/preview
   -IBM Data Science (Coursera), https://www.coursera.org/professionalcertificates/ibm-data-science

Marks Distribution for Assessment:

CIA (50)	Component	CIA (50)	SEA Conduction: 100 M Reduced to: 50 M
	Theory	Total Number of Tests: 2 Each Theory test will be conducted for 25 marks Average of 2 tests = 25 Marks	Project Assessed for 100 Marks reduced to 50 Marks
	Practical	Weekly Assessment (Record / Project) – 10 Marks	
		Lab IA Test – 15 Marks	
Total Marks – 50 Marks			**Total Marks – 50 Marks**
SEA (50)	**Component**	**Description**	**Marks**
	Project	Write up – 10 marks Project Report – 25 marks Presentation and demonstration – 50 marks Viva – voce – 15 marks	100 marks reduced to 50 marks
			Total Marks – 50 Marks
		Total marks for the Course	**100**

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective - I)

Course Name: Introduction to AI		**Course Code: 24CSE1651**
L: T: P: J	2: 2: 0: 0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
2	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
3	Learn the methods of solving problems using Artificial Intelligence.
4	Learn the knowledge representation techniques, reasoning techniques and planning

Contents	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Module-1 : Introduction		
Introduction to AI: history, Intelligent systems, foundation and sub area of AI, applications, current trend and development of AI. Problem solving: Production System, water jug problem, Missionaries and Cannibals Problem, 8-Puzzle problem, State space search, Control Strategies: Characteristics of Problem.	**8**	Apply CO 1
Module-2 : Problem solving-1		
Uninformed Search Strategies: Breadth-First search, Uniform- Cost Search, Depth first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, comparing uninformed search strategies. Informed (Heuristic) Search strategies: Best-first search, A* algorithm, Memory bounded Heuristic search-RBFS algorithm and SMA* algorithm, AO* algorithm Constraint Satisfaction Problems: Crypt-arithmetic problem	**8**	Apply CO 2
Module-3 : Game Playing		
Adversarial Search: Nim Game problem, minimax procedure, alpha-beta pruning. Advanced problem solving paradigm: Planning: types of planning system, block world problem, logic based planning, Linear planning using a goal stack, sussman anomaly problem in goal stack, Means-ends analysis	**8**	Apply CO 3
Module-4 Logical Reasoning and planning		
Logical reasoning: propositional calculus, propositional logic, Natural Deduction system, Axiomatic system, Semantic Tableau system in propositional logic, resolution refutation in propositional logic, predicate logic, logic programming, forward and backward chaining.	**8**	Apply CO4
Knowledge Representation & Expert Systems		
Knowledge Representation: Approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, Knowledge representation using Frames. Expert Systems: Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta Knowledge. Typical expert systems - MYCIN, DART, XOON.	**8**	Apply CO5

Course Outcomes: After completing the course, the students will be able to	
24CSE1651.1	Understand the concepts of AI, characteristics of problems and apply various techniques for problem solving.
24CSE1651.2	Apply appropriate search techniques to solve AI problems.
24CSE1651.3	Apply algorithms that can learn to play games and make decisions
24CSE1651.4	Develop knowledge base sentences using propositional logic and first order logic for logical reasoning.
24CSE1651.5	Apply AI techniques for knowledge representation using semantic networks and implement various expert systems.

Text Books

1. Staurt Russel, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3rd Edition, 2009.

Reference Books

1. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill
2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
3. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014
4. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980

Marks Distribution for Assessment:

CIA	Component	Description	Marks
	Written Test	• Total Number of Test: 3 • Each Theory test will be conducted for 30 marks • Average of 3 tests = 30 Marks	30
	Assignment / AAT	Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.	20
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU
Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: VI (Professional Elective - I)

Course Name: Information and Network Security		**Course Code:** 24CSE1652
L: T: P: J	**2:2:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	Analyze the cryptographic processes.
2	Summarize the digital security process.
3	Indicate the location of a security process in the given system

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction. How to Speak Crypto. Classic Crypto. Simple Substitution Cipher. Cryptanalysis of a Simple Substitution. Definition of Secure. Double Transposition Cipher. One-time Pad. Project VENONA. Codebook Cipher. Ciphers of the Election of 1876. Modern Crypto History. Taxonomy of Cryptography. Taxonomy of Cryptanalysis.	**8**	**Understand CO1**
Module-2: Hash Function		
What is a Hash Function? The Birthday Problem.Non-cryptographic Hashes. Tiger Hash. HMAC. Uses of Hash Functions. Online Bids. Spam Reduction. Other Crypto-Related Topics. Secret Sharing. Key Escrow. Random Numbers. Texas Hold 'em Poker. Generating Random Bits. Information Hiding.	**8**	**Apply CO2**
Module-3: Random number generation		
Random number generation Providing freshness Fundamentals of entity authentication Passwords Dynamic password schemes Zero-knowledge mechanisms Further reading Cryptographic Protocols Protocol basics From objectives to a protocol Analysing a simple protocol Authentication and key establishment protocols.	**8**	**Apply CO3**
Module-4: Key management fundamentals		
Key management fundamentals Key lengths and lifetimes Key generation Key establishment Key storage Key usage Governing key management Public-Key Management Certification of public keys The certificate lifecycle Public-key management models Alternative approaches	**8**	**Apply CO4**
Module-5: Cryptographic Applications		
Cryptographic Applications Cryptography on the Internet Cryptography for wireless local area networks Cryptography for mobile telecommunications Cryptography for secure payment card transactions Cryptography for video broadcasting Cryptography for identity cards Cryptography for home users.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to

25CSE1652.1	Demonstrate the fundamental principles of classical cryptography and cryptanalysis, weaknesses of historical ciphers, and describe the taxonomy and evolution of cryptographic systems.

24CSE1652.2	Illustrate the principles and applications of hash functions in cryptographic and non-cryptographic contexts and analyze their role in security mechanism.
24CSE1652.3	Demonstrate an understanding of random number generation, entity authentication methods, and cryptographic protocols, and key establishment mechanisms.
24CSE1652.4	Explain the principles and practices of key management, including key generation, distribution, storage, and lifecycle management, and evaluate various public-key infrastructure models.
24CSE1652.5	Analyze the application of cryptographic techniques across various real-world domains, including internet security, wireless networks, mobile communications, and personal data protection.

Text Books
1. Information Security: Principles and Practice, 2nd Edition by Mark Stamp Wiley 2. Everyday Cryptography: Fundamental Principles and Applications Keith M. Martin Oxford Scholarship Online: December 2013
Reference Books
1. Applied Cryptography Protocols, Algorithms, and Source Code in C by Bruce Schneier

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Presentation /Case Study	10
		Total Marks	**50**
SEA	**Component**	**Description**	**50**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective – I)

Course Name: Data Warehousing & Data Mining		**Course Code: 24CSE1653**
L: T: P: J	2: 2: 0: 0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Demonstrate different Data Warehouse Implementations
2	Interpret the features of Data Mining and Data Mining Applications.
3	Implement Association Mining Methods.
4	Implement Classification Methods.
5	Implement Cluster Analysis and recent trends in Data Mining Applications.

Contents	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Module-1: Data Warehousing		
Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Implementation, Data Preprocessing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization. **Lab Component:** Create an application to design a for a schema and OLAP operation	**6+2**	Apply CO 1
Module-2: Data Mining		
Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? Major Issues in Data Mining, Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity, Data Mining Applications. **Lab Component:** Create an application for a data preprocessing activities	**6+2**	Apply CO 2
Module-3: Association Mining		
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods, Frequent Item set Mining Methods, Which Patterns Are Interesting? Pattern Evaluation Methods, Constraint Based Frequent Pattern Mining **Lab Component:** Create an application to show the working progress of Association mining	**6+2**	Analyze CO 3
Module-4: Classification		
Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Cross-Validation, Random Forests, Bayesian Belief Networks, Classification by Back propagation. **Lab Component :** Create an application for the decision tree using B+ tree	**6+2**	Analyze CO4
Module-5: Cluster Analysis and recent trends		
Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid-Based Methods, Outlier Detection Methods, Visual and Audio Data Mining. **Lab Component:** Create an application to show the working progress of Visual and Audio Data Mining.	**6+2**	Analyze CO5

Course Outcomes: After completing the course, the students will be able to	
24CSE1653.1	Apply the data warehouse concepts for data cube problems.
24CSE1653.2	Apply the data mining solutions with data visualization techniques.
24CSE1653.3	Analyze the association rules for the data set using mining concepts.
24CSE1653.4	Analyze between the classification Algorithm methods.
24CSE1653.5	Analyze data mining problems in recent trends

Text 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.
Reference Books
1.Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson,Tenth Impression,2012. 2. Michael.J.Berry,Gordon.S.Linoff: Mastering Data Mining , Wiley Edition, second edition,2012.

Marks Distribution for Assessment:

CIA	Component	Description	Marks
	Written Test	• Total Number of Test: 3 • Each Theory test will be conducted for 30 marks • Average of 3 tests = 30 Marks	30
	Practical	Open ended experiments	10
	AAT	Online Courses	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B. N. M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective - 1)

Course Name: NOSQL Databases **Course Code:** 24CSE1654

L:T:P:J	**2:2:0:0**	**CIE Marks:50**
Credits	**3**	**SEE Marks:50**
Hours/week (Total)	**4hours/week (40 hrs)**	**SEE Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	Recognize and Describe the four types of NoSQL Databases, the Document-oriented, Key Value Pairs, Column-oriented and Graph databases useful for diverse applications.
2	Apply performance tuning on Column-oriented NoSQL databases and Document-oriented NoSQL Databases.
3	Differentiate the detailed architecture of column oriented NoSQL database, Document database and Graph Database and relate usage of processor, memory, storage and file system commands.
4	Evaluate several applications for location based service and recommendation services. Devise an application using the components of NoSQL.

Module 1	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate Oriented Databases. More Details on Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access.	**8**	**Understand CO1**
Module 2		
Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication. Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums. Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes.	**8**	**Apply CO2**
Module 3		
Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets	**8**	**Apply CO3**
Module 4		
Document Databases, What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against	**8**	**Apply CO4**

Varying Aggregate Structure.		
Module 5		
Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.	**8**	**Apply CO5**

Co. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
24CSE1654.1	Demonstrate an understanding of the detailed architecture of Column Oriented NoSQL databases, Document databases, Graph databases.	Understand
24CSE1654.2	Apply appropriate distribution and replication model	Apply
24CSE1654.3	Apply Map-Reduce and key-value store concepts to process and manage large-scale data effectively.	Apply
24CSE1654.4	Apply document database concepts to design scalable solutions for suitable applications.	Apply
24CSE1654.5	Apply graph database concepts to model and query highly connected data for use cases like recommendation engines and routing services.	Apply

Reference Books

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012.
2. Dan Sullivan, "NoSQL for Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN13: 978-9332557338)
3. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022)
4. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694).

Marks Distribution for Assessment:

CIA	Component	Description	Marks
50	Test	Total Number of Test: 3 Each Theory test will be conducted for 30 Marks Average of 3 tests = 30 Marks	30
	Assignment	10 Marks	10
	AAT	10 Marks	10
Total Marks			**50**
SEA	**Component**	**Description**	**Marks**
50	Theory Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions (2 Questions from each module with internal choice) Student should answer one full question from each module.	50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: VI (Professional Elective - I)

Course Name: Cryptographic Hash and Integrity Protection		**Course Code: 24CSE1655**
L: T: P: J	**2 :2: 0: 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Nil

Course Learning Objectives: The students will be able to

1	Learn about the three tenants of the CIA triad—confidentiality, integrity, and availability—and how they can be used to secure data.
2	Introduce message authentication and hash function.
3	To explain the basic properties that a digital signature algorithm must satisfy
4	TLS cryptographic protocol to secure network communications.

Module-1:	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to cryptography, cryptanalysis, and cryptology, Overview of cryptography, Basic Cryptographic Primitives, Vulnerabilities, Threats, and Attacks. Cryptographic attacks: CCA, COA, KPA, CPA. Objectives of Information Security: CIA triad, Confidentiality, Integrity, and Availability. Trapdoor **Laboratory Component:** 1. Columnar Transposition involves writing the plaintext out in rows and then reading the ciphertext off in columns one by one. Write a Python program to perform cryptanalysis of single columnar transposition with key size varying from 3-6.	**6** **2**	**CO1 Understand**
Module-2:		
Message Integrity, Message digest algorithm (MD5), Cryptographic Hash Function Requirements: One-Way and Collision Properties, Collision resistant hash function (CRHF), Secure Hash Algorithm (SHA), Birthday attack, Zero-knowledge protocols, Hash functions: Merkle-Damgard and Davies Meyer. **Laboratory Component:** 1. MD5 collision attack lab (ref: https://seedsecuritylabs.org/Labs_16.04/Crypto/Crypto_MD5_Collision)	**6** **2**	**CO2 Apply**
Module-3:		
Entity authentication, device authentication, Message Authentication Code (MAC) – Definition, Message Integrity, Cipher Block Chaining (CBC-MAC), Constructing Secure message Authentication codes, Authenticated Encryption, Generic Attacks on Hash Functions, Random Oracle Model, Applications,	**6**	**CO3 Apply**

Laboratory Component: 1. Hash length extension attack Ref: https://seedsecuritylabs.org/Labs_16.04/Crypto/Crypto_Hash_Length_Ext/	**2**	
Module-4:		
Identification protocols, Digital Signature (DS): Certificates and Public Infrastructure, Attacks, Schemes, Applications, Signatures from Hash Functions. Elliptic Curve cryptography-based signature (ECDSA), RSA-based signature, **Laboratory Component:** 1. RSA signature and encryption lab Ref: https://seedsecuritylabs.org/Labs_16.04/Crypto/Crypto_RSA/	**6** **2**	**CO4 Evaluate**
Module-5:		
Case Study: TLS, Hash Tree (Merkle Tree), Cryptographic Hash Applications: blockchain, cryptocurrency, and Bitcoin **Laboratory Component:** 1. Create self-signed certificates in Python.	**6** **2**	**CO5 Apply**

Course Outcomes: After completing the course, the students will be able to	
24CSE1655.1	Classify cryptographic attacks.
24CSE1655.2	Make use of the hash for data integrity.
24CSE1655.3	Make use of authentication algorithms for message authentication
24CSE1655.4	Choose an appropriate digital signature.
24CSE1655.5	Utilize TLS for data security.

Text Books
1. **"Introduction to Modern Cryptography",** Jonathan Katz, Yehuda Lindell, 2nd Edition, CRC Press, 2015.
Reference Books
1. **"Cryptography and Network Security"** Behrouz A.Foruzan, 3rd Edition, Tata McGraw Hill, 2017

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 15 Marks	15
	Practical	Lab IA / Continuous Evaluation	25
	AAT	Quiz, Presentations.	10
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N.M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester: VI (Professional Elective - I)

Course Name: Advanced Computer Architecture **Course Code:** 24CSE1656

L: T: P: J	**2:2:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 3 Hours

Course Learning Objectives: The students will be able to

1	Describe computer architecture.
2	Measure the performance of architectures in terms of right parameters.
3	Summarize parallel architecture and the software used for them.
4	Understanding of the interaction amongst architecture, applications, and technology.

Module-1:	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Theory of Parallelism: Parallel Computer Models, Multiprocessors and Multicomputer, Multivector and SIMD Computers, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Speedup Performance Laws, Scalability Analysis and Approaches.	**8**	**Understand CO1**
Module-2:		
Hardware Technologies: Processors and Memory Hierarchy, Advanced Processor Technology, Superscalar Processors, Vector processor, Memory Hierarchy Technology, Virtual Memory Technology Sequential and Weak Consistency Models	**8**	**Apply CO2**
Module-3:		
Bus, Cache, and Shared Memory, Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design	**8**	**Analyze CO3**
Module-4:		
Parallel and Scalable Architectures: Multiprocessors and Multicomputers, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Message-Passing Mechanisms, Multivector and SIMD Computers ,Vector Processing Principles, Multivector Multiprocessors , ,SIMD Computer Organizations, Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, Fine-Grain Multicomputers, Scalable and Multithreaded Architectures	**8**	**Analyze CO4**
Module-5:		
Parallel Models, Languages, and Compilers, Parallel Programming Models, Parallel Languages and Compilers, Dependence Analysis of Data Arrays ,Parallel Program Development and Environments, Synchronization and Multiprocessing Modes, Instruction and System Level Parallelism, Instruction Level Parallelism, Operand Forwarding ,Reorder Buffer, Register Renaming, Tomasulo's Algorithm, Branch Prediction.	**8**	**Analyze CO5**

Case study: Sun's Niagara and IBM's Cell Broadband Engine.		

Course Outcomes: After completing the course, the students will be able to	
24CSE1656.1	Understand the organization of Parallel processing models, Multiprocessors, and Multicomputers and their performance measures using the right parameters.
24CSE1656.2	Apply the concept of memory hierarchy used in superscalar and vector processors.
24CSE1656.3	Analyze different types of bus and cache memory organizations of linear and nonlinear pipeline processors.
24CSE1656.4	Analyze the cache coherence and synchronization mechanism of parallel and scalable architectures.
24CSE1656.5	Analyze the concept of register renaming in hardware, reservation stations for all execution units, and different case studies on multicore architectures.

Text Books
1. Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability, Kai Hwang and Naresh Jotwani, McGraw Hill Education,3/e, 2015
Reference Books
1. Computer Architecture: A quantitative approach, John L. Hennessy and David A. Patterson, Morgan Kaufmann Elsevier,5/e, 2013

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Presentation / Demonstration of mini project	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz/Presentations/Two-minute video on latest topic/ Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective - II)

Course Name: Digital Image Processing		**Course Code: 24CSE1661**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To **understand** and to become familiar with the fundamentals of Digital Image Processing.
2	To get **exposed** to simple image enhancement techniques in Spatial domain
3	To get **exposed** to simple image enhancement techniques in Frequency domain
4	**Describe** the idea of morphological image processing
5	To **interpret** the image segmentation and representation techniques.

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction to Digital Image Processing, The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. **(*Text Book-1, Chapter 1, Page no: 17 to 44)*** **Digital Image Fundamentals:** Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels. **(*Text Book-1, Chapter 2, Page no: 47 to 79)***	**8**	**Remember(L2) CO1**
Module-2 : INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING		
Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, smoothing (Lowpass) Spatial Filters, Sharpening (High pass) Spatial Filters, High pass, Band reject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods ***(Text Book-1: Chapter 3, Page no: 122 to 191)***	**8**	**Apply(L3) CO2**
Module-3 : FILTERING IN THE FREQUENCY DOMAIN:		
Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Some Properties of the 2-D DFT and IDFT, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using High Pass Filters, Selective Filtering. ***(Text Book-1: Chapter 4, Page no: 204 to 296)***	**8**	**Analyse (L4) CO3**
Module-4: MORPHOLOGICAL IMAGE PROCESSING:		
Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Some Basic Morphological Algorithms, Morphological Reconstruction, Summary of Morphological Operations on Binary Images, Grayscale Morphology. ***(Text Book-1: Chapter 9, Page no: 638 to 674)***	**8**	**Analyse (L4) CO4**
Module-5: IMAGE SEGMENTATION:		

Fundamentals, Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Super pixels Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds. ***(Text Book-1: Chapter 10. Page no: 700 to 786)***	**8**	**Apply(L3) CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1661.1	Explain the fundamentals of image processing and the mathematical transforms involved.
24CSE1661.2	Interpret the techniques of smoothing, sharpening and enhancement in spatial domain and frequency domain for object detection and recognition.
24CSE1661.3	Analyze the impact of different segmentation techniques on images.
24CSE1661.4	Analyze the process involved in morphological image processing,explain the morphological operations on binary images
24CSE1661.5	Illustrate the concept of image segmentation using Clustering, Graph Cuts, Morphological Watersheds.

Text Books

1. Digital Image Processing, Rafael C. Gonzalez & Richard E. Woods, Fourth Edition, Pearson Publishing, 2018.
2. A. K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2004

Reference Books

1. Scott. E. Umbaugh, "Computer Vision and Image Processing", Prentice Hall, 1997.
2. Kenneth R. Castleman, _Digital Image Processing ', Pearson, 2006.
3. D,E. Dudgeon and RM. Mersereau, _Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
	IA	IA Test: 3 IA tests - Each of 30 Marks - Average of 3 tests	30
	Assignment	Application based	10
	Quiz	Assessment through quiz to test the applicability level	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
	Theory Exam	5 questions to answer each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 = 100 M reduced to 50 M
		Total marks for the Course	**100(Reduced to 50)**

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective - II)

Course Name: MALWARE ANALYSIS AND REVERSE ENGINEERING
Course Code: 24CSE1662

L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To recognize commonly used file formats.
2	To identify conditional execution constructs in disassembled files.
3	To Use a debugger to monitor program execution.
4	To analyze malware samples packed using common packing techniques in GHIDRA/IDA.

	No. of Hours	**Blooms Cognitive Levels with CO mapping**
Module-1: BASIC ANALYSIS		
Basic Static Techniques, Malware Analysis in Virtual Machines, Basic Dynamic Analysis	**8**	**L1, CO1**
Module-2: ADVANCED STATIC ANALYSIS		
Crash Course in x86 Disassembly, IDA Pro, Recognizing C Code Constructs in Assembly	**8**	**L1, CO2**
Module-3: ADVANCED DYNAMIC ANALYSIS		
Analyzing Malicious Windows Programs, Debugging, OllyDbg.	**8**	**L3, CO3**
Module-4: MALWARE FUNCTIONALITY		
Malware Behavior, Covert Malware Launching, Data Encoding	**8**	**L2, CO4**
Module-5: ANTI-REVERSE-ENGINEERING		
Anti-Disassembly, Anti-Debugging, Anti-Virtual Machine Techniques	**8**	**L1, CO5**

Course Outcomes: After completing the course, the students will be able to

24CSE1662.1	Recognize commonly used file formats and techniques for analyzing a malicious program.
24CSE1662.2	Understand high level functionality of assembly code for analyzing malware.
24CSE1662.3	Employ a debugger to monitor program execution.
24CSE1662.4	Describe common malware functionality.
24CSE1662.5	Identify conditional execution constructs in disassembled files.

Text Books

1. Practical Malware Analysis: The Hands-on Guide to Dissecting Malicious Software" by Michael Sikorski and Andrew Honig (published by No Starch Press, 2012)

Reference Books

1. The IDA PRO Book: The Unofficial Guide to the World's Most Popular Disassembler, 2nd Edition" by Chris Eagle (published by No Starch Press, 2011.

Marks Distribution for Assessment:

CIA	Component	Description	Marks
	Test	Total Number of Test: 3 Each Theory test will be conducted for 30 Marks Average of 3 tests = 30 Marks	30
	Assignment	10 marks	10
	AAT	10 marks	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
	Theory Exam	5 Questions to answer of 20 Marks 2 Questions from each module with internal choice. Student should answer one full question from each module.	100 Reduced to 50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/course/malware-analysis-and-reverse-engineering/
- https://archive.ringzer0.training/archive/2021-january/advanced-malware-analysis.html
- https://www.youtube.com/watch?v=f-fMdnUW4X4
- https://doc.lagout.org/security/Malware%20%26%20Forensics/Practical%20Malware%20Analysis.pdf (Textbook)

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Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective - II)

Course Name: DevOps		**Course Code: 24CSE1663**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4(40)	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the challenges in Software Eng. and Continuous Integration and Continuous Delivery
2	Know how DevOps is applied and used in Software Development cycle.
3	Know how DevOps can be applied in testing phase of SDLC.
4	To understand the DevOps tools used in each phase of software development activity.
5	To appreciate the use of DevOps post software development and deployment.

Module1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Introduction to DevOps and Continuous Delivery: Introducing DevOps, how fast is fast? The Agile wheel of wheels, Beware the cargo cult Agile fallacy. **A View from Orbit:** The DevOps process and Continuous Delivery, Release management, Scrum, Kanban, and the delivery pipeline, wrapping up – a complete example, Identifying bottlenecks	**8**	**Understand CO1**
Module 2		
Everything is Code: The need for source code control, The history of source code management, Roles and code, Which source code management system?, A word about source code management system migrations, Choosing a branching strategy, Branching problem areas, Artifact version naming. Choosing a client, Setting up a basic Git server, Shared authentication, Hosted Git servers, Introduction to Docker and its applications.	**8**	**CO2 Apply**
Module 3		
Building the Code: Why do we build code?, The many faces of build systems, The Jenkins build server, Managing build dependencies, The final artifact, Continuous Integration, Continuous Delivery, Jenkins plugins, The host server, Build slaves, Software on the host, Triggers. Job chaining and build pipelines, A look at the Jenkins filesystem layout, Build servers and infrastructure as code, Build phases, Alternative build servers, Collating quality measures, About build status visualization, Taking build errors seriously	**8**	**CO3 Apply**
Module 4		

Testing the Code: Manual testing, Pros and cons with test automation, Unit testing, JUnit in general and JUnit in particular, A JUnit example, Mocking, Test Coverage, Automated integration testing, Performance testing, Automated acceptance testing, Automated GUI testing, JavaScript testing, Testing backend integration points, A complete test automation scenario	**8**	**CO4 Apply**
Module 5: Pipelining and Multiprocessors		
Deploying the Code: Why are there so many deployment systems?, Virtualization stacks, Executing code on the client, The Puppet master and Puppet agents, Cloud solutions, AWS, Azure.	**8**	**CO5 Apply**

Laboratory Component

1. Exploring Git and Github Commands.
2. Practice Source code management on GitHub.
3. Working on Jenkins installation and setup, exploring the environment.
4. Integrating Github with Jenkins and compiling the code
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Creating pipeline in Jenkins to add Junit test cases.
9. Write a Program for DevOps Testing.
10. Branching on GitHub, controlling features with GitHub.

Course Outcomes: After completing the course, the students will be able to	
24CSE1663.1	Understand the Software Engg process, and challenges
24CSE1663.2	Know how Devops is applied and used in Software Development cycle.
24CSE1663.3	Know the application of DevOps in Software Development activity
24CSE1663.4	Identify the application of DevOps in Software Testing and Validation activity
24CSE1663.5	Build familiarity of application of DevOps in Software Deployment phase

Text Books
1. Joakum Verona, “Practical DevOps”, Packt Publishing Limited, 2016
Reference Books
Jennifer Davis, Ryn Daniels, “Effective DevOps”, O’reilly Publications, 2016.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Theory Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 15 Marks	15
		AAT – 10 Marks	10
	Practical	Weekly Assessment – 10 Marks	10
		IA Test – 15 Marks	15
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
Total marks for the Course			**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

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Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective – II)

Course Name: Augmented reality and Virtual reality **Course Code: 24CSE1664**

L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4**	**SEA Duration:** 03 Hours

Pre-Requisites: Basic mathematics, and Computer aided design

Course Learning Objectives: The students will be able to

1	Understand the design and implementation of the hardware that enables VR systems to be built.
2	Explain the concepts of motion and tracking in VR systems
3	Overview of Computer Graphics along with its applications and OpenGL primitives and attributes
4	Illustrate different fill area attributes to animate the images.
5	Exploring 2D and 3D graphics mathematics along with OpenGL API's.

Module-1: Introduction to computer graphics	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality. Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR	**8**	**Apply CO1**
Module-2:		
Visual Perception, Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies **Case Studies:** A virtual Study Use Case- NICE, An Educational Experience	**8**	**Apply CO2**
Module-3:		
Overview: Basics of computer graphics, Application of Computer Graphics, Random Scan and Raster Scan displays, graphics software. OpenGL: Introduction to OpenGL, coordinate reference frames, OpenGL point functions, OpenGL line functions, point attributes, line attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms (DDA, Bresenham‟s**.** Color and gray scale, OpenGL Color Functions. **Laboratory Component:** **1. Design a line using DDA line drawing algorithm** **2. Implement Brenham‟s line drawing algorithm for all types of slope.** **3. Design a real world picture using primitives such as points, lines, triangles and polygons.** **4. Design, develop and implement recursively subdivide a tetrahedron to form 3D sierpinski gasket. The number of recursive steps is to be specified by the user**	**8**	**Apply CO3**
Module-4:		
2D and 3D viewing pipeline, OpenGL 2D viewing functions. **Fill area Primitives**: Polygon fill-areas, OpenGL polygon fill area functions, fill area attributes, general scan line polygon fill algorithm, OpenGL fill-area attribute functions. Color and gray scale, OpenGL Color Functions. circle generation algorithms (Bresenham‟s). Input and Interaction: OpenGL interactive input device functions, Menus Picking, Animating Interactive programs. **Laboratory Component:** **1. Implement a circle drawing algorithm.**	**8**	**Apply CO4**

2. Develop a menu driven program to fill the polygon using scan line algorithm **3. Implement the program to draw a polygon that interact with interact with input functions.**		
Module-5:		
2D and 3D Geometric Transformations: 2DGeometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates. Inverse transformations, 2D Composite transformations, other 2D transformations, OpenGL geometric transformation's function. 3D Geometric Transformations: Translation, rotation, scaling, composite 3D transformations, other 3D transformations, OpenGL geometric transformations functions. **Laboratory Component:** 1. **Create and rotate a triangle about the origin and a fixed point.** 2. **Draw a colour cube and spin it using OpenGL transformation matrices.** **Develop a program to show different transformations.**	**8**	**Apply CO4**
Laboratory Component: 1) Create a 3D object and Apply different geometric Transformations using Mouse/Keyboard 2) Create animation for a 3D object (transformation, color, texture, etc.) 3) Bouncing ball on multiple 2D/3D platforms 4) Develop First Person Controller to a Scene 5) Create a 3D Character movement 6) Create a menu driven interface for adding and removing objects from a Scene 7) Build a cubic room, whose sides are made out of six planes. The room should be 15x15x15 Unity units. At the center of the roof of the room, place a point source of light. This light should change color by pressing the Tab key. 8) Finding target using 2D Ray-caster 9)Create a loading bar (health bar, progress bar, start bar) 10)Create and show motion effect using time scale and scripts for 2D images.		

Course Outcomes: After completing the course, the students will be able to	
24CSE1664.1	Apply the concepts of VR systems work and list the applications of VR.
24CSE1664.2	Apply the concepts of motion and tracking in VR systems
24CSE1664.3	Apply Computer Graphics along with its applications and OpenGL primitives and attributes
24CSE1664.4	Apply different fill area attributes to animate the images
24CSE1664.5	Apply 2D and 3D graphics mathematics along with OpenGL API's.

Text Books

1. Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version,3rd / 4th Edition, Pearson Education,2011
2. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008
3. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
4. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
5. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

e-Books:
http://lavalle.pl/vr/book.html

MOOC Courses:
https://nptel.ac.in/courses/106/106/106106138/
https://www.coursera.org/learn/introduction-virtual-reality

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 2 ● Each test will be conducted for 50 marks out of which 15 marks for theory and 35 marks for lab test. ● Average of 2 tests to 30 Marks	30
	AAT	Presentation / Demonstration of mini project and weekly assessment.	20
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	External lab exam will be conducted for 100 marks and scaled down to 50 Marks (project presentation)	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective - II)

Course Name: Cyber Security and Digital Forensics **Course code: 24CSE1665**

L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To familiarize cybercrime terminologies and perspectives.
2	To understand Cyber Offenses and Botnets.
3	To gain knowledge on tools and methods used in cybercrimes.
4	To understand phishing and computer forensics.

Module	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Module-1: Introduction to Cybercrime		
Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives	**8**	**L1, CO1**
Module-2: Cyber Offenses		
How Criminals Plan Them: Introduction, how criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector.	**8**	**L2, CO2**
Module-3: Tools and Methods used in Cybercrime		
Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks.	**8**	**L2, CO3**
Module-4: Phishing and Identity Theft		
Introduction, methods of phishing, phishing, phishing techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft	**8**	**L2, CO4**
Module-5: Understanding Computer Forensics		
Introduction, Historical Background of Cyberforensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics.	**8**	**L2, CO5**

Course Outcomes: After completing the course, the students will be able to

24CSE1665.1	Explain the cybercrime terminologies.
24CSE1665.2	Describe Cyber offenses and Botnets.
24CSE1665.3	Illustrate Tools and Methods used on Cybercrime.
24CSE1665.4	Explain Phishing and Identity Theft.
24CSE1665.5	Justify the need of computer forensics.

Text Books
1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, First Edition (Reprinted 2018)
Reference Books
1. Cybersecurity Essentials, Charles J. Brooks, Christopher Grow, Philip A. Craig Jr., Donald Short, ISBN: 978-1-119-36239-5, October 2018.

Marks Distribution for Assessment:

CIA	Component	Description	Marks
	Test	Total Number of Test: 3 Each Theory test will be conducted for 30 Marks Average of 3 tests = 30 Marks	30
	Assignment	10 marks	10
	AAT	10 marks	10
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
	Theory Exam	5 Questions to answer of 20 Marks 2 Questions from each module with internal choice. Student should answer one full question from each module.	100 Reduced to 50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=dm9xZIzDhwM&list=PLFW6lRTa1g80JCqzslAXGHMFIo2AJ_qyb
- https://www.youtube.com/watch?v=OYsY5B9pqYU&list=PLyqSpQzTE6M-jkJEzbS5oHJUp2GWPsq6e

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: High performance Computer Architecture
Course Code: 24CSE1666

L: T: P: J	**2 : 0 : 2 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	To understand advanced concepts in computer architecture for performance improvement.
2	To explore instruction-level, thread-level, and data-level parallelism.
3	To learn about modern memory hierarchy, cache organization, and interconnects.
4	To understand multicore, GPU, and vector processors.
5	To analyze and optimize performance using benchmarks and architectural techniques.

Module-1: Fundamentals of High Performance Architecture	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Basic structure of modern processors, Performance metrics: CPI, MIPS, MFLOPS,Amdahl's Law and Gustafson's Law, Instruction Set Architectures (ISA): RISC vs CISC,Pipelining: Basic concepts, hazards, forwarding, branch prediction	**8**	**Understand 1,2,3,12**
Module-2: Instruction-Level Parallelism (ILP)		
ILP concepts: static and dynamic scheduling, Tomsula's algorithm, Speculative execution, branch prediction techniques, Superscalar and VLIW architectures, Out-of-order execution and register renaming	**8**	**Analyze 1,2,3,12**
Module-3: Memory Hierarchy and Caching		
Memory hierarchy design: latency vs bandwidth, Cache organization: direct-mapped, set-associative, fully-associative, Cache performance and optimization techniques, Virtual memory and TLBs, Prefetching and memory-level parallelism (MLP)	**8**	**Analyze 1,2,3,12**
Module-4: Multiprocessors and Multicore Architectures		
Shared memory multiprocessors, Interconnection networks: bus, crossbar, mesh; Cache coherence: MESI protocol, Multithreading: fine-grained, coarse-grained, simultaneous, Multicore processor design and performance scaling	**8**	**Analyze 1,2,3,12**
Module-5: Vector, SIMD, GPU, and Heterogeneous Architectures		

Vector processing and SIMD extensions (AVX, SSE),GPU architecture: CUDA cores, warps, memory hierarchy,Heterogeneous computing (CPU + GPU, CPU + FPGA),Parallel programming models: CUDA, OpenCL,Case studies: NVIDIA, AMD, Apple M-series	**8**	**Analyze 1,2,3,12**

Course Outcomes: After completing the course, the students will be able to	
23CSE1666.1	Understand system performance and identify bottlenecks along with pipelining and its impact on throughput.
23CSE1666.2	Analyze ILP and its enhanced methods along with dynamic scheduling and speculative execution.
23CSE1666.3	Evaluate cache configurations and performance along with memory optimizations for high throughput.
23CSE1666.4	Analyze interprocessor communication, synchronization and coherence strategies.
23CSE1666.5	Analyze vector and GPU-based parallelism, hardware acceleration and co-processing.

Text Books

1. **John L. Hennessy and David A. Patterson** – *Computer Architecture: A Quantitative Approach*, 6th Edition, Morgan Kaufmann.
2. **Kai Hwang** – *Advanced Computer Architecture: Parallelism, Scalability, Programmability*, McGraw Hill.
3. **David E. Culler and Jaswinder Pal Singh** – *Parallel Computer Architecture*, Morgan Kaufmann.

Reference Books

1. An Introduction to Parallel Computing, Design and Analysis of Algorithms,Grama, A. Gupta, G. Karypis, V. Kumar, Addison-Wesley 2/e, 2003 .
2. Scalable Parallel Computing, Kai Hwang ,McGraw Hill 1998.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Open Elective – II)

Course Name: Storage Area Networks **Course Code: 24CSE1671**

L: T: P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Define backup, recovery, disaster recovery, business continuity, and replication.
2	Examine emerging technologies including IP-SAN.
3	Understand logical and physical components of a storage infrastructure.
4	Identify components of managing and monitoring the data center.
5	Define information security and identify different storage virtualization technologies

Module-1: Storage System	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Storage System: Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. **Data Center Environment:** Application Database Management System (DBMS), Disk Drive Components, Disk Drive Performance Direct-Attached Storage, Storage Design Based on Application.	**8**	**Apply CO1**
Module-2: Data Protection - RAID		
Data Protection - RAID: RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison. **Intelligent Storage Systems:** Components of an Intelligent Storage System, Types of Intelligent Storage Systems**. Fibre Channel Storage Area Networks** - Fibre Channel: Overview, The SAN and Its Evolution, Components of FC SAN.	**8**	**Apply CO2**
Module-3: Network-Attached Storage		
Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance.	**8**	**Apply CO3**
Module-4: Introduction to Business Continuity		
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis. **Backup and Archive:** Backup Purpose, Backup Considerations, Backup and Restore Operations.	**8**	**Analyze CO4**
Module-5: Local Replication		
Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica. **Remote Replication:** Modes of Remote Replication, Remote Replication Technologies.	**8**	**Analyze CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1671.1	Apply storage Networking technologies and virtualization to identify key challenges in managing information.
24CSE1671.2	Apply the storage infrastructure and management activities of intelligent storage system and identify the Components of FC SAN.
24CSE1671.3	Apply the knowledge of storage area network to key components and for implementation of Network Attached Storage.
24CSE1671.4	Analyze the concept of Storage Security Issues and the impact of storage architecture, types of archives and forms of virtualization.
24CSE1671.5	Analyze the information security and identify different storage virtualization technologies with business continuity, and replication.

Text Books
1. EMC Education Services, Information Storage and Management, Wiley India Publications, 2009. ISBN: 9781118094839.
Reference Books
1.Paul Massiglia, Richard Barker, Storage Area Networks Essentials: A Complete Guide to Understanding and Implementing SANs Paperback",1st Edition, Wiley India Publications,2008.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Presentation /Case Study	10
		Total Marks	**50**
SEA	**Component**	**Description**	**50**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

An Autonomous Institute Under VTU
Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Open Elective – II)

Course Name: Computer Graphics and Visualization		**Course Code:** 24CSE1672
L: T: P: J	**3: 0: 0 :0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Computer Aided design

Course Learning Objectives: The students will be able to

1	Overview of Computer Graphics along with its applications
2	Illustrate OpenGl primitives and attributes
3	Make use of different fill area attributes to animate the images.
4	Exploring 2D and 3D graphics mathematics along with OpenGL API's.
5	Demonstrate clipping and illumination models on both 2D and 3D objects.

Module-1:	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Overview: Basics of computer graphics, Application of Computer Graphics, video display processor, Refresh Cathode Ray Tubes, Random Scan and Raster Scan displays, Input Devices, graphics software. coordinate reference frames, Specifying a two-dimensional world coordinate reference frame in openGL. Introduction to OpenGL. Color and gray scale, OpenGL Color Functions.	**8**	**Understand CO1**
Module-2:		
OpenGL point functions, OpenGL line functions, point attributes, line attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms (DDA, Bresenham‟s), circle generation algorithms (Bresenham‟s). Fill area Primitives: Polygon fill-areas, OpenGL polygon fill area functions, fill area attributes. **Sample programs**: 1. Design a line using DDA line drawing algorithm 2. Implement Brenham‟s line drawing algorithm for all types of slope. **3.** Design a real world picture using primitives such as points, lines, triangles and polygons.	**8**	**Apply CO2**
Module-3:		
2D and 3D viewing pipeline, OpenGL 2D viewing functions, OpenGL Character Functions, OpenGL Display Lists, general scan line polygon fill algorithm, OpenGL fill-area attribute functions. Polyhedra, OpenGL Polyhedra Functions, Curved Surfaces, Quadric Surfaces, OpenGL quadric surfaces and cubic surface functions. **Sample programs**: 1. Implement a circle drawing algorithm. **2.** Develop a menu driven program to fill the polygon using scan line algorithm	**8**	**Apply CO3**
Module-4:		
2D and 3D Geometric Transformations: 2DGeometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates. Inverse transformations, 2D Composite transformations, other 2D transformations, OpenGL geometric transformations function. 3D Geometric Transformations: Translation, rotation, scaling, composite 3D transformations, other 3D transformations, OpenGL geometric transformations functions. **Sample programs:** 1. Create and rotate a triangle about the origin and a fixed point. 2. Draw a colour cube and spin it using OpenGL transformation matrices**.**	**8**	**Apply CO4**
Module-5:		

Clipping and Color and Illumination Models: Clipping: clipping window, normalization and viewport transformations, clipping algorithms,2D point clipping, 2D line clipping algorithms: cohen-sutherland line clipping only -polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm only. Color Models, Light Sources, Basic illumination Models. Sample programs: 1. Clip a lines using Cohen-Sutherland algorithm. 2. Develop a program to show the different quadric surfaces.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1672.1	Understand the fundamentals of computer graphics
24CSE1672.2	Design and implement algorithms for 2D graphics primitives and attributes
24CSE1672.3	Apply 2D viewing and quadric surfaces
24CSE1672.4	Apply Geometric transformations on both 2D and 3D objects.
24CSE1672.5	Apply various clipping and illumination models

Text Books

1. Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version,3rd / 4th Edition, Pearson Education,2011
2. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008

Reference Books

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

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Presentation / Demonstration of mini project	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions from each module.	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU
Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Open Elective – II)

Course Name: Modern Web Development and UI/UX Design **Course Code: 24CSE1673**

L: T: P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:
Basic the concepts of security Fundamentals.

Course Learning Objectives: The students will be able to

1	Build dynamic, responsive, and performant web applications using modern front-end and back-end technologies.
2	Understand and apply the principles of UI/UX design to craft user-centered digital experiences.
3	Integrate design thinking into the development workflow to bridge the gap between visual aesthetics and functionality.
4	Utilize component-based architectures, RESTful APIs, and deployment strategies for scalable web systems.
5	Conduct user research, prototyping, and usability testing to iteratively improve product experience.

Module-1:	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Foundations of Modern Web Development: HTML5 and Semantic Markup, CSS3 (Flexbox, Grid, Media Queries), JavaScript ES6+ Syntax and Features, DOM Manipulation and Events, Developer Tools and Browser Rendering, Accessibility (WCAG), SEO Essentials Self-study: Build a responsive landing page and optimize it for accessibility and SEO.	**8**	**Apply CO1**
Module-2:		
Frontend Frameworks and Component Architecture : Introduction to React.js, JSX and Component Lifecycle, State and Props, Hooks (useState, useEffect, useContext), Routing with React Router, Forms and Validation, API Integration with Fetch/Axios, State Management Patterns Self-study: Create a multi-page React application with client-side routing and external API integration.	**8**	**Apply CO 2**
Module-3:		
UI/UX Design Principles and Tools: Design Thinking Process, User Research and Persona Creation, Wireframing and Prototyping with Figma, Typography, Color Theory, Layout and Spacing Systems, Interaction Design and Micro interactions, Design Systems and Component Libraries Self-study: Redesign an existing app interface and present rationale based on	**8**	**Analyse CO3**

user-centered principles.		
Module-4:		
Backend Development and Integration: Topics Covered: Introduction to Node.js and Express.js, RESTful API Design and Routing, Working with Databases (MongoDB or PostgreSQL), Authentication (JWT, OAuth), Middleware and Error Handling, Environment Variables and Deployment Config, Connecting Frontend to Backend Self-study: Build a full-stack CRUD app with user authentication and role-based access.	**8**	**Analyse CO4**
Module-5:		
Testing, Optimization, and Deployment: Responsive Testing (Mobile-first), Performance Optimization (Lazy Loading, Code Splitting), Unit and Integration Testing (Jest, React Testing Library), CI/CD Basics, Hosting with Vercel/Netlify/Render, Web Security Practices, Lighthouse Audits and Performance Metrics Self-study: Audit an existing web app for performance and push improvements with measurable metrics.	**8**	**Analyse CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1676.1	Build web development using HTML5 and Semantic Markup, CSS3
24CSE1676.2	Apply React.js concepts in designing responsive web pages
24CSE1676.3	Develop UI/UX Design Principles and Tools
24CSE1676.4	Develop front end applications connecting with backend databases
24CSE1676.5	Utilize proper testing methods and optimization techniques

Text Books

1. David Griffiths & Dawn Griffiths, “Fullstack Web Development with React and Node", Publisher: O’Reilly Media, ISBN: 978-1492051718
2. Steve Krug, “Don't Make Me Think: A Common-Sense Approach to Web Usability" (3rd Edition), Publisher: New Riders, ISBN: 978-0321965516

Reference Books

1. Marijn Haverbeke**, Eloquent JavaScript: A Modern Introduction to Programming" (3rd Edition) Publisher:** No Starch Press, **ISBN:** 978-1593279509
2. Rex Hartson & Pardha Pyla **“The UX Book: Agile UX Design for a Quality User Experience" (2nd Edition), Publisher:** Morgan Kaufmann, **ISBN:** 978-0128053423

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	Total Number of Test: 3 Each Theory test will be conducted for 30 marks. Average of 3 tests = 30 Marks (Scaled down to 15 marks)	15
	Lab Test / Weekly Assessment		25
	Assignment / AAT		10
Total Marks			**50**
	Component	**Description**	**Marks**
SEA (50)	Written Exam	5 Questions to answer, each of 20 marks. 2 Questions from each module with internal choice. Student should answer one full question from each module.	20*5=100 Scale down to 50
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Machine Learning		**Course Code: 24CSE1674**
L: T: P: J	3:0:0:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the types of classifications and dimensionality reduction techniques.
2	To become acquainted with regression, classification, and error functions.
3	To become acquainted with the concepts of ensemble, clustering and reinforcement learning.
4	Show scholarly expertise in the application of and analysis of machine learning algorithms to address various learning challenges.

Module-1: Introduction to Machine Learning	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction, What is Human Learning, Types of Human learning, What is Machine Learning, Types of Machine Learning, Applications of Machine Learning, Issues in machine Learning, Basic Types of Data in Machine Learning, Exploring Structure Data, Data Quality and Remediation.	**8**	**Understand CO1**
Module-2: Supervised Machine Learning - I		
Introduction, Examples of Supervised Machine Learning, Classification Model, Classification Learning Steps, Classification Algorithms: KNN, Naïve Bayes, Support Vector Machine, Decision Tree: Bagging & Boosting.	**8**	**Apply CO2**
Module-3: Supervised Machine Learning - II		
Introduction to Neural Networks, Perceptron, Multi-layer Perceptron, Backpropagation. Regression: Introduction to Regression, Example of Regression. Regression Algorithms: Linear Regression, Logistic Regression.	**8**	**Apply CO3**
Module-4: Unsupervised Machine Learning - I		
Introduction to Unsupervised, Application of Unsupervised, Clustering: K-Means, K-Medoid, Hierarchical, EM algorithm, Density-based methods-DBSCAN.	**8**	**Apply CO4**
Module-5: Unsupervised Machine Learning - II		
Introduction to Association Analysis, Apriori Algorithm, Advantages and Disadvantages of Apriori Algorithm. Introduction to Dimensionality Reduction, Principal Component Analysis, Linear Discriminant Analysis, Singular Value Decomposition.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to

24CSE1674.1	Understand the basic concepts of Machine Learning.
24CSE1674.2	Apply supervised classification learning models on real-world applications.
24CSE1674.3	Apply supervised neural networks and regression learning models on real-world applications.
24CSE1674.4	Apply unsupervised clustering models on real-world applications.

24CSE1674.5	Apply unsupervised association analysis and dimensionality reduction models on real-world applications.

Text Books

1. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Fifth Edition 2020, Pearson Publisher.
2. Tom M. Mitchell, -Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
3. Ethem Alpaydin, "Introduction to machine learning", second edition, PHI publication, 2010
4. Shai Vaingast, " Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd Edition, 2014.

Reference Books

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
2. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. John L. Semmlow, Benjamin Griffel, Biosignal and Medical Image Processing, 3rd Ed, CRC Press, 2014.
4. Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006
5. Stephen Marsland, - Machine Learning: An Algorithmic Perspective, Second Edition, 2014.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	AAT	Assignment/Presentation / Demonstration of mini project	20
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Open Elective – II)

Course Name: Technology and Transformation **Course Code: 24CSE1675**

L: T: P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Basic the concepts of IT Fundamentals.

Course Learning Objectives: The students will be able to

1	Learn the concepts of IT Fundamentals in different applications
2	Learn the concepts of RDBMS Using Oracle in diverse applications
3	Learn the concepts of Web responsive in diverse presentations
4	Learn the Programming Fundamentals Java in diverse applications
5	Learn the DevOps & Cloud Fundamentals in altered solicitations

Module-1: IT Fundamentals	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
. Topics include: Conditions, iterations and Arrays in a Pseudocode, features of Agile and its benefits, various tiers of an application, the difference between layered and tiered architecture and Object-Oriented Principles (OOP) - Abstraction, Encapsulation, Hierarchy, Polymorphism, Modularity, Typing and Persistence.	8	**Apply CO 1**
Module-2: RDBMS Using Oracle		
Topics include: Data is creation, organization, storage, to retrieve from a database and working with the Oracle database to perform various computations, and functions. RDBMS concepts Data definition, Data manipulation, select statements, Scalar & Aggregate functions, Joins and Subqueries, Views.	8	**Apply CO 2**
Module-3: Responsive Web Designing		
Topics include: web page with different layouts, styles with bootstrap, and perform validation, effects and animations and learn the Basics of web design fundamentals, HTML 5,CSS3, Bootstrap, JavaScript and jQuery.	8	**Analyse CO 3**
Module-4: Programming Fundamentals Java		
Topics include: You will be able to implement various object-oriented features and design and program stand-alone Java applications, and you will learn the basics of Java, Eclipse IDE, Classes and Objects, Array and Strings, Regular expression	8	**Analyse CO 4**
Module-5: DevOps & Cloud Fundamentals		
Topics include: You will understand the Cloud Computing Concepts and AWS Basics and will learn concepts like Intro to cloud, DevOps & GIT, Azure Fundamentals, AWS Cloud Practitioner, GCP Essentials	8	**Analyse CO 5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1675.1	Apply the concepts of IT Fundamentals in different applications
24CSE1675.2	Apply the concepts of RDBMS Using Oracle in diverse applications
24CSE1675.3	Apply the concepts of Web responsive in diverse presentations
24CSE1675.4	Analyze the Programming Fundamentals Java in diverse applications
24CSE1675.5	Analyze the DevOps & Cloud Fundamentals in altered solicitations

Text Books
1. PwC learning platform - https://pwc.tekstac.com/login/index.php
Reference Books
1. The Java Programming Language, Ken Arnold, David Holmes, James Gosling, Prakash Goteti, 3rd Edition, Pearson 2. Java: The Complete Reference by Herbert Schildt, 9th Ed, 2017

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Micro certifications of PWC	10
	AAT	Java real time coder approach	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Department of Computer Science and Engineering
VII Semester
Scheme of Teaching 2024 – 28 Batch

Sl. No.	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Hours Per Week	Credits	Examination		
					Lecture	Tutorial	Practical	Project					
					L	T	P	J			CIA	SEA	Total
1	PCI-P	24CSE171	Robotic Process Automation	CSE	2	-	2	-	4	3	50	50	100
2	PEC	24CSE172X	Professional Elective III	CSE	2	-	2	-	4	3	50	50	100
3	PEC	24CSE173X	Professional Elective IV	CSE	3	-	-	-	3	3	50	50	100
4	AEC	24CSE174	Research Methodology and Intellectual Property Rights	CSE	2	1	-	-	3	2	50	50	100
5	PW	24CSE175	Project Work Phase - I	CSE	-	-	-	8	8	4	100	-	100
Total					9	1	4	8	22	15	300	200	500

Professional Elective – III			
24CSE1721	Deep Learning	24CSE1722	Storage Area Networks
24CSE1723	Agentic AI	24CSE1724	Advanced in Web Technologies
24CSE1725	Block Chain Technology	24CSE1726	Quantum Computing
Professional Elective – IV			
24CSE1731	Algorithmic Game Theory	24CSE1732	Foundation of Cloud IoT Edge ML
24CSE1733	Process Mining	24CSE1734	User Interface Design
24CSE1735	Ethical Hacking	24CSE1736	Understanding Incubation and Entrepreneurship

CIE: Continuous Internal Evaluation, SEE: Semester End Examination, NCMC: Non Credit Mandatory Course AICTE Activity Points to be earned by students admitted to BE day college programme (For more details refer t Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other institutions and Universitie to the fifth semester are required to earn 50 Activity Points from the year of entry to BNMIT. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over th years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning th required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

BSC → Basic Science	PW → Project Work	MAT → Mathematics	PEC → Professional Elective	INT → Internship
PBL → Project Based Learning	OEC → Open Elective	HUM → Humanities and Social Science	PCC → Professional Core Course	PCI → Professional Core Course Integrated
AEC → Ability Enhancement Course	UHV → Universal Human Values			

Dept. of Computer Science & Engineering
BNM Institute of Technology
Bangalore - 560 070

Additional Director & Principal
BNM Institute of Technology
Bangalore - 560 070

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII

Course Name: Robotic Process Automation		**Course Code: 24CSE171**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the purpose and benefits of Robotic Process Automation.
2	Learn the creation of process flows using RPA platforms.
3	Describe the various types of Sequence and Control flow.
4	Create software bots for automating tasks.
5	Apply the concepts of RPA for developing various application bots.

Module-1: Introduction to RPA	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
What is RPA, History of RPA, Scope and Benefits, Components of RPA, RPA Platforms- The future of automation, Record and Play, Downloading and installing UiPath Studio, Working with UiPath Studio, Task Recorder, Applications of RPA	**8**	**Understand CO1**
Sample Programs: 1. Program to Reversing a String		
Module-2: Working with RPA Studio		
The User Interface, Variables - Managing Variables, Collections, Data Types, The Arguments Panel - Using Arguments -, Types of workflows/files, File operation with step-by-step example-CSV/Excel – Creating message boxes, Reading and writing data to applications.	**8**	**Apply CO2**
Sample Programs: 1. Creation of Message boxes and Assigning activities.		
Module-3: RPA Workflows		
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 exercises.	**8**	**Apply CO3**
Sample Programs: 1. Programs using Control Flow statements – If – For – Whiles.		
Module-4: Automation and Control		
Finding and attaching windows, Act on controls - mouse and keyboard activities - Performing automation tasks – Act on controls - mouse and keyboard activities, Exercises involving automating actions involving keyboard and mouse controls.	**8**	**Apply CO4**
Sample Programs: 1. Automating the Window Controls. 2. Automating Mouse and Keyboard controls. 3. Moving Files from Source to Destination.		

Module-5: Advanced Automation Activities		
Data Scrapping and Screen Scrapping, When to use OCR, Types of OCR available, How to use OCR, Scraping advanced techniques - Selectors - Defining and Assessing Selectors – Automation tasks with PDFs and Data tables – Web Scrapping and Extraction – Exercises involving OCR activity and Web scrapping.	**8**	**Apply CO5**
Sample Programs: 1. Web Scrapping. 2. Screen scrapping of Google Contacts. 3. Message Automation.		

Course Outcomes: After completing the course, the students will be able to	
24CSE171.1	Understand the basic concepts and platforms of RPA.
24CSE171.2	Experiment with RPA platforms and build activities.
24CSE171.3	Construct RPA workflows and perform data manipulation.
24CSE171.4	Apply various Screen control techniques to automate screen activities.
24CSE171.5	Build software bots to perform advanced automation tasks.

Textbooks

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant
3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
50	Test	Total Number of Test: 2 Each Theory test will be conducted for 30 Marks Average of 2 tests = 30 Marks	30
	Weekly Assignment	Lab Record	10
		Performance	5
		Viva	5
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Theory part	5 Questions to answer of 20 Marks (6M * 5= 30M) 2 Questions from each module with internal choice. Student should answer one full question from each module.	30
	Execution Part	Writeup – 20 Marks Conduction – 40 Marks Viva Voce – 10 Marks	70
		Total marks for the Course	**100**

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII (Professional Elective – III)

Course Name: Deep Learning		**Course Code: 24CSE1721**
L:T:P:J	**2:0:2:0**	**CIA Marks:**50
Credits:	**3**	**SEA Marks:**50
Hours/Week (Total)	**40**	**SEA Duration:**03Hours

Pre-Requisites: Linear Algebra, Probability and Statistics, Python Programming, Machine Learning Fundamentals, Problem-Solving and Critical Thinking

Course Learning Objectives: The students will be able to

1	Understand the fundamentals of deep learning.
2	To become acquainted with Convolutional Neural Networks and error functions.
3	To become acquainted with the various types of learning tasks in various domains.
4	Implement deep learning algorithms and solve real-world problems.

Module-1:	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Machine Learning and Deep Learning Overview: Introduction to Supervised Learning Algorithms and Data Collection, Learning Algorithms, Overfitting and Underfitting, Hyperparameters and Validation Sets, Bias and Variance, Unsupervised Learning Algorithms, Building a Machine Learning Algorithm, Challenges Motivating Deep Learning. 1. Practice with model training, evaluation, and result visualization. 2. Training models with varying training set sizes.	**6** **2**	**Apply CO 1**
Module-2:		
Neural Network: Introduction, The Human Brain, Models of a Neuron, Neural Networks Viewed as Directed Graphs, Feedback, Network Architectures, Perceptron, Multilayer Perceptron, XOR Problem, Back Propagation Learning, Optimization Techniques, Gradient Descent, Batch Optimization, SGD 1. Define a simple neural network model. 2. Solve the XOR problem using a Multilayer Perceptron. 3. Apply backpropagation and visualize training loss. 4. Experiment with optimization methods (SGD, Batch Gradient Descent).	**6** **2**	**Analyze CO 2**
Module-3:		
Convolution Neural Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning 1. Understand and implement basic CNN operations such as convolution, pooling, and classification using image data.	**6** **2**	**Apply CO 3**
Module-4:		
Optimization for Training Deep Models: Building blocks of CNN, Challenges in Neural Network Optimization, Transfer Learning, Effective training in Deep Net-early stopping, Dropout, Batch Normalization, Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN, RNN, LSTM, Introduction to Deep Learning for Object Detection-YOLO 1. Apply effective optimization techniques (Early Stopping, Dropout, Batch Normalization) and Transfer Learning using a pretrained CNN.	**6** **2**	**Apply CO 4**

2. Understand and implement RNN. 3. Use a pre-trained YOLOv5 or YOLOv8 for object detection on sample images.		
Module-5:		
Practical Methodology: Performance Metrics, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition Applications, Large Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications. 1. Apply deep learning to multi-digit number recognition. 2. Explore practical applications in computer vision, speech recognition, and NLP.	**6** **2**	**Apply CO 5**

Note*: 1. For Laboratory components, use any platforms such as MATLAB or ANACONDA
2 Sample laboratory components are specified in each model.

Course Outcomes: After completing the course, the students will be able to	
24CSE1721.1	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
24CSE1721.2	Analyze and interpret the concepts of neural networks relating to artificial intelligence
24CSE1721.3	Design deep learning models using regularization and convolutional operations.
24CSE1721.4	Implement deep learning algorithms and solve real-world problems.
24CSE1721.5	Execute performance metrics of Deep Learning Techniques.

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016. https://www.deeplearningbook.org/lecture_slides.html
2. Zhang, Aston, et al. "Dive into deep learning." arXiv preprint arXiv:2106.11342 (2021).
3. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

Reference Books

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
2. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
3. Neural Networks and Deep Learning, Charu C Agarwal, 1st Edition, Springer, 2016.
4. Neural Networks - A Comprehensive Foundation - Simon Haykin, 2nd edition.
5. Stephen Marsland, - Machine Learning: An Algorithmic Perspective, Second Edition, 2014.
6. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, O'Reilly Publications, 2016 edition.
7. Python Deep Learning, Ivan Vasilev et.al, Packt Publishing, 2nd edition, 2019.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCI</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th></th><th colspan="3">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 Marks
Reduced: 50 Marks</th></tr>
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Lab IA Test – 15 Marks
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B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI (Professional Elective – III)

Course Name: Storage Area Networks		**Course Code: 24CSE1722**
L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Define backup, recovery, disaster recovery, business continuity, and replication.
2	Examine emerging technologies including IP-SAN.
3	Understand logical and physical components of a storage infrastructure.
4	Identify components of managing and monitoring the data center.
5	Define information security and identify different storage virtualization technologies

Module-1: Storage System	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Storage System: Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. **Data Center Environment:** Application Database Management System (DBMS), Disk Drive Components, Disk Drive Performance Direct-Attached Storage, Storage Design Based on Application.	**8**	**Apply CO1**
Module-2: Data Protection - RAID		
Data Protection - RAID: RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison. **Intelligent Storage Systems:** Components of an Intelligent Storage System, Types of Intelligent Storage Systems**. Fibre Channel Storage Area Networks** - Fibre Channel: Overview, The SAN and Its Evolution, Components of FC SAN.	**8**	**Apply CO2**
Module-3: Network-Attached Storage		
Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance.	**8**	**Apply CO3**
Module-4: Introduction to Business Continuity		
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis. **Backup and Archive:** Backup Purpose, Backup Considerations, Backup and Restore Operations.	**8**	**Analyze CO4**
Module-5: Local Replication		
Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica. **Remote Replication:** Modes of Remote Replication, Remote Replication Technologies.	**8**	**Analyze CO5**

Course Outcomes: After completing the course, the students will be able to

24CSE1722.1	Apply storage Networking technologies and virtualization to identify key challenges in managing information.
24CSE1722.2	Apply the storage infrastructure and management activities of intelligent storage system and identify the Components of FC SAN.

24CSE1722.3	Apply the knowledge of storage area network to key components and for implementation of Network Attached Storage.
24CSE1722.4	Analyze the concept of Storage Security Issues and the impact of storage architecture, types of archives and forms of virtualization.
24CSE1722.5	Analyze the information security and identify different storage virtualization technologies with business continuity, and replication.

Text Books
1. EMC Education Services, Information Storage and Management, Wiley India Publications, 2009. ISBN: 9781118094839.
Reference Books
1.Paul Massiglia, Richard Barker, Storage Area Networks Essentials: A Complete Guide to Understanding and Implementing SANs Paperback",1st Edition, Wiley India Publications,2008.

Marks Distribution for Assessment:

CIA	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Presentation /Case Study	10
		Total Marks	**50**
SEA	**Component**	**Description**	**50**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII (Professional Elective – III)

Course Name: Agentic AI		**Course Code: 24CSE1723**
L: T: P: J	2 : 0 : 2 : 0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	4 hours/week = 40 hours	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understanding, identifying, navigating Agentic AI concepts with Ethical and responsible AI.
2	Data Processing, state management in AI agent, implement and deploying agents
3	Understanding and Implementing / building Agentic RAG,
4	Learn multi agent systems, workflow, build adaptive AI agents
5	Building AI agents with No/Low – Code Tools

Module	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Module-1: Introduction Agentic AI Introduction AI Agents vs. Agentic AI Comparison: Agentic AI, Generative AI, and Traditional AI Agentic AI Building Blocks Autonomous Agents Human in the Loops Systems Single and Multi Agent AI Systems Agentic AI Frameworks Overview Ethical and Responsible AI Agentic AI Best Practices AI Implementation Success Stories: Case Studies. Agentic AI Architecture Agentic Architecture Types Key Components of the Agentic AI Framework Perception Module Cognitive Module Action Module Learning Module Collaboration Module Security Module Agentic AI Design Patterns Reflection Pattern Tool Use Pattern Planning Pattern ReAct (Reasoning and Acting) and ReWOO (Reasoning with Open Ontology) Multi Agent Pattern Design Considerations **Hands on:** Analyzing AI Agent Use Cases Exploring Agentic AI Frameworks. Designing an AI agent architecture Implementing different agentic AI design patterns.	**8**	
Module-2: Working with LangChain and LCEL		
Components and Modules Data Ingestion and Document Loaders Text Splitting Embeddings Integration with Vector Databases Introduction to Langchain Expression Language (LCEL) Runnables Chains Building and Deploying with LCEL Deployment with Langserve. Introduction to LangGraph State and Memory. State Schema State Reducer Multiple Schemas Trim and Filter Messages Memory and External Memory UX and Human-in-the-Loop (HITL) Building Agent with LangGraph Long Term Memory Short vs. Long Term Memory Memory Schema Deployment **Hands-on:** Build a Self-correcting Coding Assistant with LangChain. Building a Finance Bot with LangGraph.	**8**	
Module-3: Implementing Agentic RAG		
What is Agentic RAG? Agentic RAG vs. Traditional RAG Agentic RAG Architecture and Components Understanding Adaptive RAG. Variants of Agentic RAG Applications of Agentic RAG Agentic RAG with Llamaindex Agentic RAG with Cohere. Agents Models Tools Knowledge Chunking Vector DB Storage Embeddings	**8**	

Workflows Developing Agents with Phidata **Hands-on:** Create an AI-Powered Sales Report Analyzer with LlamaIndex, Create a Market Research Agent with RAG & Cohere. Design a Data Analysis Agent with Phidata.		
Module-4: Multi Agent Systems with LangGraph and CrewAI		
Multi Agent Systems Multi Agent Workflows Collaborative Multi Agents Multi Agent Designs Multi Agent Workflow with LangGraph CrewAI Introduction CrewAI Components Setting up CrewAI environment Building Agents with CrewAI. Autogen Introduction Salient Features Roles and Conversations Chat Terminations Human-in-the-Loop Code Executor Tool Use Conversation Patterns Developing Autogen-powered Agents Deployment and Monitoring **Hands-on:** Build a Customer Support Chatbot with LangGraph, Design a Stock Analysis Agent with CrewAI Develop an AI Research Agent with Autogen	**8**	
Module-5: Building AI Agents with No/Low- Code Tools		
Langfuse Overview Langfuse Dashboard Tracing, Evaluation Managing Prompts Experimentation AI Observability with Langsmith Setting up Langsmith Managing Workflows with Langsmith AgentOps Practical Implementation. Introduction to No-Code/Low-Code AI Benefits and Challenges of No-Code AI Development Key Components of No-Code AI Platforms Building AI Workflows Without Coding Designing AI Agents with Drag-and-Drop Interfaces Integrating No-Code AI with Existing Systems Customizing and Fine-Tuning AI Solutions, ptimizing Performance and Efficiency in No-Code AI Security and Compliance Considerations in No-Code AI Best Practices for Deploying No-Code AI Solutions Real-World Use Cases and Applications of No-Code AI Scaling and Future Trends in No-Code AI **Hands-on:** AI Observability with Langsmith, AgentOps Practical Implementation Content Writer Agent in Wordware, Design Your own SEO Agent with Relevance AI, Creating an AI Agent with Langflow	**8**	

Course Outcomes: After completing the course, the students will be able to	
24CSE1723.1	Explore and navigate the core concepts of Agentic AI with a focus on ethics and responsible AI practices.
24CSE1723.2	Master data processing and state management in AI agents, including implementation and deployment strategies.
24CSE1723.3	Understand and develop Agentic Retrieval-Augmented Generation (RAG) systems for enhanced information synthesis.
24CSE1723.4	Gain insights into multi-agent systems and workflows to design adaptive and collaborative AI agents.
24CSE1723.5	Build intelligent AI agents using low-code and no-code platforms for rapid prototyping and deployment.

Text Books
Agentic Artificial Intelligence: Harnessing AI Agents to Reinvent Business, Work, and Life, by, Pascal Bornet (Author), Jochen Wirtz (Author), Thomas H Davenport (Author)
Reference Courses
The complete Agentic AI engineering course by Udemy. https://www.youtube.com/watch?v=upblQZigz0U https://www.youtube.com/watch?v=w0H1-b044KY

Marks Distribution for Assessment:

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B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII (Professional Elective – III)

Course Name: Advanced Web Technologies **Course Code: 24CSE1724**

L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand and apply modern frontend technologies such as React.js or Angular to build interactive user interfaces.
2	Design and implement secure RESTful APIs using backend frameworks like Node.js and Express.
3	Integrate frontend and backend components to build dynamic full stack applications.
4	Employ real-time web technologies and advanced web features such as WebSockets, GraphQL, and PWAs.
5	Implement DevOps practices including containerization, CI/CD pipelines, and cloud deployment of web applications.

Module-1: Modern Front Development	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to Single Page Application (SPA), Modern JavaScript (ES6+ Features: Arrow Functions, Promises, Async/wait, Modules), Introduction to React JS/Angular: Components, Props/Inputs, State, Events, React Hooks/Angular Directives, Routing(React/Angular Router), Component Lifecycle and performance optimization.	**8**	**Apply CO1**
Sample Programs: 1. Build a SPA with routing and state management.		
Module-2: Backend with Node.js and Express.js		
Introduction to Server-side JavaScript with Node.js, Express.js fundamentals: routing, middleware, templating, RESTful APIs: GET, POST, PUT, DELETE, connecting to databases: MongoDB / MySQL, Authentication using JWT / Sessions.	**8**	**Apply CO2**
Sample Programs: 1. Develop a REST API with Express + MongoDB		
Module-3: Full Stack Integration		
Connecting frontend (React/Angular) with backend (Express.js), State management using Context API or Redux, Asynchronous communication with Axios / Fetch API, Deployment-ready build and environmental configuration.	**8**	**Analyze CO3**
Sample Programs: 1. Create a Full Stack CRUD App (MERN Stack suggested).		
Module-4: Advanced Topics in Web Technologies		
WebSocket's and real-time applications (chat, notifications), GraphQL vs REST, Progressive Web Apps (PWA) – service workers, offline support Web security: Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), HTTPS, CORS, Secure Headers.	**8**	**Apply CO4**
Sample Programs: 1. Real-time chat app with Socket.IO		

Module-5: DevOps, Testing & Deployment		
Introduction to CI/CD pipelines, Containerization with Docker, Deployment to cloud platforms: Vercel, Netlify, Heroku, or AWS, Testing basics: Unit testing (Jest/Mocha), API testing (Postman), Performance tuning & analytics	**8**	**Apply CO5**
Sample Programs: 1. Dockerize and deploy a full stack app with CI/CD basics.		

Course Outcomes: After completing the course, the students will be able to	
24CSE1724.1	Design and develop single-page applications using modern frontend frameworks.
24CSE1724.2	Build scalable and secure backend services using Node.js and Express.js.
24CSE1724.3	Connect frontend and backend for full-stack development.
24CSE1724.4	Implement real-time features and secure authentication mechanisms.
24CSE1724.5	Deploy full stack applications with containerization and CI/CD practices.

Textbooks
1. Learning React by Alex Banks and Eve Porcello, O'Reilly Media. 2. Node.js Design Patterns by Mario Casciaro, Packt Publishing. 3. MDN Web Docs, React.js Docs, Express.js Docs.
Reference Books
1. Anthony Accomazzo, Nate Murray, Ari Lerner, "Fullstack React: The Complete Guide to ReactJS and Friends" FullStack.io publisher. 2. Kristina Chodorow, "MongoDB: The Definitive Guide", O'Reilly Media publisher. 3. Nigel Poulton, "Docker Deep Dive", Leanpub publisher.

Marks Distribution for Assessment:

PCI	**CIA**	**SEA**		**CIA (50)**			**SEA**
				I	**II**	**III**	**Conduction: 100 Marks** **Reduced: 50 Marks**
	50	**50**	**Written Test**	30	30	30	Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module
				Average of three tests – 30 marks (scaled down to 15 marks)			
			Activity	10 Marks			
			Practical	Weekly Assessment – 10 Marks Lab IA Test – 15 Marks (IA test to be conducted for 30 M and scaled down to 15M)			
			Total – 50 Marks				**Total – 50 Marks**

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII (Professional Elective – III)

Course Name: Blockchain Technology		**Course Code: 24CSE1725**
L: T: P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Basic the concepts of security Fundamentals.

Course Learning Objectives: The students will be able to

1	Learn the concepts of security Fundamentals in different applications
2	Learn the concepts of e-blockchain decentralization and cryptography concepts
3	Learn the concepts of the Bitcoin features and its alternative options.
4	Learn the Programming Fundamentals and deploy the smart contracts
5	Learn the blockchain features outside of currencies.

Module-1: Blockchain : Distributed systems	**No. of Hours**	**BLL, CO**
Blockchain : Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, Benefits and limitations of blockchain	**8**	**Apply CO1**
Module-2: Decentralization using blockchain		
Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptographic primitives, Asymmetric cryptography, Public and private keys	**8**	**Apply CO 2**
Module-3: Bitcoin		
Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, IOTA	**8**	**Analyse CO3**
Module-4: Smart Contracts		
Smart Contracts and Ethereum: Smart Contracts: Definition, Ethereum; Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.	**8**	**Analyse CO4**
Module-5: Alternative Blockchains		
Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media	**8**	**Analyse CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1725.1	Understand the types, benefits and limitation of blockchain.
24CSE1725.2	Explore the blockchain decentralization and cryptography concepts.
24CSE1725.3	Enumerate the Bitcoin features and its alternative options.
24CSE1725.4	Describe and deploy the smart contracts
24CSE1725.5	Summarize the blockchain features outside of currencies.

Text Books

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017

Reference Books

1. Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016
2. 2 Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017
3. 3 Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	Total Number of Test: 3 Each Theory test will be conducted for 30 marks. Average of 3 tests = 30 Marks (Scaled down to 15 marks)	15
	Lab Test / Weekly Assessment		25
	Assignment / AAT		10
Total Marks			50
SEA (50)	Component	Description	Marks
	Written Exam	5 Questions to answer, each of 20 marks. 2 Questions from each module with internal choice. Student should answer one full question from each module.	20*5=100 Scale down to 50
		Total marks for the Course	100

B.N.M. Institute of Technology

Dept. of Computer Science & Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII (Professional Elective – III)

Course Name: Quantum Computing		**Course Code: 24CSE1726**
L: T: P: J	**3:0:0 :0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4 (40)**	**SEA Duration:** 03 Hours

Pre-Requisites: : Discrete Mathematics, Applied Physics, Computational Number Theory, Mathematics I

Course Learning Objectives: The students will be able to

1	To understand the components of computing in a Quantum world
2	To gain knowledge on mathematical representation of quantum physics and operations.
3	To analyse the various Quantum algorithms needed to solve the real world problems

Module-1: : Introduction to Quantum Computing	**No. of Hours**	**Blooms Cognitive Levels**
Introducing quantum mechanics: Introduction & Types of Computing, History of Classical Electronic Computing and Quantum Computing, How Is a Quantum Computer Different, Quantum kinematics, quantum dynamics, quantum measurements. Single qubit, multiqubit, gates	**8**	**Understand CO1**
Module-2: Matrices & Operators		
Observables, The Pauli Operators, Outer Products, The Closure Relation, Representations of Operators Using Matrices,Outer Products and Matrix Representations Matrix Representation of Operators in Two-Dimensional Spaces, Hermitian, Unitary, and Normal Operators, Eigenvalues and Eigenvectors, Spectral Decomposition, The Trace of an Operator the Expectation Value of an Operator Functions of Operators	**8**	**Apply CO2**
Module-3: Quantum Cryptography		
Cryptography, classical cryptography, introduction to quantum cryptography. BB84, B92 protocols. Introduction to security proofs for these protocols. quantum key distribution, Quantum error correction.	**8**	**Analyze CO3**
Module-4: Quantum gates and algorithms		
Quantum gates and algorithms: Universal set of gates, quantum circuits Single Qubit Gates; Quantum Not Gate, Pauli-X,Y and Z Gates, Hadamard Gate, Phase Gate or S Gate T Gate or 8 Gate Multiple Qubit Gates; Controlled Gates, Controlled Not Gate or CNOT Gate, Swap Gate, Controlled Z Gate, Toffoli Gate	**8**	**Analyze CO4**
Module-5: Quantum Algorithms		
Classical computation on quantum computers, Relationship between quantum and classical com plexity classes. Deutsch-Jozsa algorithm, Grover's quantum search algorithm, Simon's algorithm. Shor's quantum factorization algorithm. Bernstein Vazirani Algorithm	**8**	**Analyze CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1726.1	Understand the basics of quantum computing
24CSE1726.2	Apply the various operators needed for Quantum Mechanics..
24CSE1726.3	Analyse the computation models..
24CSE1726.4	Model the circuits using quantum computation.
24CSE1726.5	Analyse the need of quantum computing. using various algorithms

Text Books

1) Edward Franklin , Madison Matti Charlton, "Mastering Quantum Computing: Practical Applications and Programming", Telephasic Workshop, 2024

2) John Gribbin , "Quantum Computing from Colossus to Qubits: The History, Theory, and Application of a Revolutionary Science", 2024

3) Kuldeep Singh Kaswan, Jagjit Singh Dhatterwal, Anupam Baliyan, Shalli Rani, "Quantum Computing: A New Era of Computing", Wiley-IEEE Press, July 2023

Reference Books

1) Nikhil Ranjan Roy (Author), Kuntal Mukherjee (Author), "Introductory Quantum Computing: A Practical Approach Using Python", S Chand and Company Ltd, 2024

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106106232
- https://www.coursera.org/learn/introduction-to-quantum-information
- https://www.udemy.com/course/quantum-computers/?couponCode=THANKSLEARNER24

https://www.youtube.com/watch?v=evTGcFnLu1g

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Activity to demonstrate all the phases of the software development life cycle (Poster Presentation)	10
	AAT	Conduct quiz after 1st IA /Assignments	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU
Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: VII

Course Name: Foundation of Edge IOT Cloud ML **Course Code: 24CSE1732**

L: T: P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	To introduce the basic concepts and architectures of cloud computing, edge computing, and the Internet of Things (IoT).
2	To develop an understanding of containerization tools and platforms for edge deployment.
3	To apply machine learning techniques for real-time IoT applications at the edge.
4	To explore task offloading strategies, distributed system algorithms, and federated learning in edge-cloud environments.

Module-1: Cloud & Edge Foundations + IoT Essentials	**No. of Hours**	**BLL, CO**
Edge computing needs: latency, QoS vs cloud limitations, Definitions and system paradigms: Edge, Fog, Cloud continuum, IoT architecture and platforms; time and clock synchronization in IoT, Hands-on with devices and network-level concepts	**8**	**Understand CO1**
Module-2: Containerization and Edge ML Basics		
Basics of Virtualization vs Containerization, Docker: Images, Containers, Volumes, Networking, Docker and Kubernetes for edge deployment, Image-classifier and predictive maintenance models on-device, Introduction to ML Concepts: Supervised vs Unsupervised Learning.	**8**	**Apply CO2**
Module-3: Deep Reinforcement Learning + Cloud Services		
Basics of Reinforcement Learning: Agent, Environment, Reward, Deep RL techniques applied to edge-cloud orchestration, Case studies using public cloud services (AWS, Azure, GCP) for system design	**8**	**Apply CO3**
Module-4: Task Offloading and Distributed Algorithms		
Vertical vs Horizontal Task Offloading, LSTM Basics for Sequence Prediction and Load Forecasting, Models of Distributed SystemsTask allocation models: LSTM prediction-based, Distributed snapshot and clock-sync algorithms in IoT-edge systems	**8**	**Apply CO4**
Module-5: Streaming, Edge Storage, Federated Learning & Edge AI		
Data pipelines using MQTT and Kafka, Edge data center architecture and key-value store design, Federated Learning and Edge ML deployment using platforms like AWS IoT, Autonomous-driving case study and overall system integration	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1732.1	Understand and explain the architecture and working of cloud, edge, and IoT systems.
24CSE1732.2	Deploy and manage IoT workloads using containers and Kubernetes at the edge.
24CSE1732.3	Apply ML models for predictive maintenance and classification on resource-constrained devices.
24CSE1732.4	Apply deep reinforcement learning methods and task offloading strategies in edge-cloud systems.
24CSE1732.5	Design scalable and intelligent systems using edge ML, federated learning, and streaming frameworks

Text Books

1. Rajkumar Buyya and Satish Narayana Srirama, Fog and Edge Computing: Principles and Paradigms, Wiley, 2019.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.
3. Rajiv Misra, Chittaranjan Hota, Cloud and Distributed Computing: Algorithms and Systems, Wiley, 2020.

Reference Books

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-on Approach, Universities Press, 2014.
2. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 3rd Edition, 2022.
3. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, 4th Edition, 2015.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Assignment	10
	AAT	AAT	10
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
Total marks for the Course			**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M. Institute of Technology

An Autonomous Institute Under VTU
Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VII

Course Name: Research Methodology and IPR **Course Code:** 24CSE174

L: T: P: J	**2:1:0:0**	**CIA Marks:** 50
Credits:	**2**	**SEA Marks:** 50
Hours/Week (Total)	**2**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To give an overview of the research methodology and explain the technique of defining a research problem
2	To explain the functions of literature review, carry out literature search and develop conceptual frameworks
3	To explain various experimental designs in research and data handling like data sampling and data collection methods
4	To interpret the research findings and prepare a research report
5	To build awareness on the various forms of IPR and to build the perspectives on the concepts and to develop the linkages in technology innovation and IPR.

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research Process, Criteria of Good Research Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.	**6**	**Understand CO1**
Module-2:		
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, How to review the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, Developing a conceptual framework, writing about the literature reviewed. Research Design: Meaning of Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.	**6**	**Apply CO2**
Module-3:		
Design of Sampling: Introduction, Sample Design, Sampling and Non- sampling Errors, Types of Sampling Designs. Data Collection: Qualitative and Quantitative Data, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection. Testing of Hypotheses: Hypothesis, Basic Concepts concerning Testing of Hypotheses, Procedure for Hypothesis Testing, P-Value approach, Limitations of the Tests of Hypothesis.	**6**	**Apply CO3**
Module-4:		
Interpretation: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation. Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Various templates for report and paper writing	**6**	**Analyze CO4**
Module-5:		

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied, Regime in India, Patents Act, 1970, Trade Mark Act, 1999, The Designs Act, 2000, Copyright Act,1957, The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property, Organisation (WIPO), WIPO and WTO, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Introduction to Patents and Copyrights. Case study on company IPR.	**6**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE174.1	Understand and define research problem
24CSE174.2	Explain and carry out literature review based on the research problem
24CSE174.3	Apply sampling and data collection techniques and carry out parametric tests of Hypothesis for the research problem. Interpret the research findings and create a report
24CSE174.4	Interpret the research findings and create a report
24CSE174.5	Explain various forms of IPR and develop the linkages in technology innovation and IPR

Text Books

1. C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International 4 th Edition, 2018.
2. Ranjit Kumar, "Research Methodology a step-by-step guide for beginners" (For the topic Reviewing the literature under module 2), SAGE Publications 3 rd Edition, 2011.
3. Firuza Karmali (Aibara), " A Short Introduction to LaTeX: A Book for Beginners", Create space Independent Publishing Platform, 2019.
4. Trochim, "Research Methods: the concise knowledge base", Atomic Dog Publishing 2005. 5. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications 2009.

Marks Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Review Paper Writing	10
	AAT	Case Study	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students must answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B. N. M. Institute of Technology

An Autonomous Institute Under VTU

Department of Computer Science and Engineering
VIII Semester
Scheme of Teaching 2024 – 28 Batch

Sl. No.	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Hours Per Week	Credits	Examination		
					Lecture	Tutorial	Practical	Project					
					L	T	P	J			CIA	SEA	Total
1	PEC	24CSE181X	Professional Elective V	CSE	3	-	-	-	3	3	50	50	100
2	INT	24CSE182	Internship	CSE	-	-	8	-	8	4	50	50	100
3	PW	24CSE183	Project Work Phase - II	CSE	-	-	-	20	20	10	50	50	100
Total					3	-	8	20	31	17	150	150	300

Professional Elective – V			
24CSE1811	Learning Deep Architectures for AI	24CSE1812	Edge Computing
24CSE1813	Business Intelligence & Analysis	24CSE1814	Mobile App Development (Flutter/Kotlin)
24CSE1815	Privacy and Security in Online Social Media	24CSE1816	Parallel Computing System

CIE: Continuous Internal Evaluation, SEE: Semester End Examination, NCMC: Non Credit Mandatory Course AICTE Activity Points to be earned by students admitted to BE day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other institutions and Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to BNMIT. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

BSC → Basic Science	PW → Project Work	MAT → Mathematics	PEC → Professional Elective	INT → Internship
PBL → Project Based Learning	OEC → Open Elective	HUM → Humanities and Social Science	PCC → Professional Core Course	PCI → Professional Core Course Integrated
AEC → Ability Enhancement Course	UHV → Universal Human Values			

Head of the Department
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Additional Director & Principal
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B. N. M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VIII (Professional Elective – V)

Course Name: Edge Computing **Course Code: 24CSE1812**

L: T: P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**40**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the Fundamentals of Edge Computing.
2	Analyse Networking and Routing in Edge Environments.
3	Learn the architecture of edge analytics, integration of edge analytics with machine learning.
4	Familiarize with the Edge data security mechanisms.
5	Explore real-world edge computing use cases.

Module-1: Fundamentals of Edge Computing	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to Edge Computing Scenarios: Edge computing purpose and definition, Edge computing hardware architectures, Operating Systems, Edge platforms. Sensing devices, High performance IoT endpoints. Textbook 1: Chapter 8 and Chapter 3	8	L2 (Understand)
Module-2: Edge Routing and Networking		
TCP/IP network function at edge: Routing functions, PAN to LWAN, Failover and out-of-band management, Edge level network security: VLANs, VPN, Traffic & QoS, Service functions, Metrics and Analytics, Software Defined Networking: Architecture, Traditional internetworking and benefits. Textbook 1: Chapter 9	8	L4 (Analyse)
Module-3: Edge Analytics		
Types of Data, Data Analytics, Goals of Data Analytics, Domains Benefiting from Big Data Analytics, Real-Time Applications of Data Analytics, Phases of Data Analytics, Types of Data Analytics, Edge Data Analytics, Potential of Edge Analytics, Architecture of Edge Analytics, Machine Learning for Edge Devices, Edge Analytics: Case Study. Textbook 2: Chapter 3: 3.1 – 3.12	8	L4 (Analyse)
Module-4: Edge Data Security		
Data Security, Data Confidentiality Authentication, Privacy-Preserving Schemes, Edge-Based Attack Detection and Prevention. Blockchain Architecture and Fundamentals, Edge Computing with Blockchain	8	L3 (Apply)

Textbook 2: Chapter 4: 4.1-4.5, Chapter 5: 5.3,5.8,5.10		
Module-5: Edge Computing Use Cases and Case Studies		
Use Cases, Edge Computing High-Potential Use Cases, Realization of Edge Computing in Healthcare Ensuring Storage Security, Conclusions and Open Research Challenges. Textbook 2: Chapter 6:6.1-6.3	8	L3 (Apply)

Course Outcomes: After completing the course, the students will be able to	
24CSE1812.1	Describe the underlying hardware architectures and platforms that support edge computing scenarios.
24CSE1812.2	Analyze the network functions at the edge including, failover strategies.
24CSE1812.3	Analyze the various types of edge data analytics and the use of machine learning in edge data analytics.
24CSE1812.4	Apply the principles of data security for attack detection and prevention in edge computing.
24CSE1812.5	Apply knowledge of edge computing to analyze the high-potential use cases in various fields.

Text Books

1. "Fog and Edge Computing: Principles and Paradigms", Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley, 2019
2. Anitha Kumari, G. Sudha Sadasivam, D. Dharani and M. Niranjanamurthy, "Edge Computing Fundamentals, Advances and Applications", CRC Press, 2022

Reference Books

1. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama
2. Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, Fog Computing and Its Role in the Internet of Things, MCC'12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978- 1-4503-1519-7/12/08.
3. Shanhe Yi, Cheng Li, Qun Li, A Survey of Fog Computing: Concepts, Applications and Issues, Mobidata'15, ACM 978-1-4503-3524-9/15/06, DOI: 10.1145/2757384.2757397, June 21, 2015, Hangzhou, China.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Assignment	10
	AAT	AAT	10
Total Marks			**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
Total marks for the Course			**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VIII (Professional Elective – V)

Course Name: Business Intelligence & Analysis		**Course Code: 24CSE1813**
L: T: P: J	3:0:0:0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	3	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Explain the Business Intelligence, Analytics and Decision Support system.
2	List the process for Decision making, Automated decision systems.
3	Explain sentiment analysis techniques.
4	Illustrate multi-criteria Decision-making systems.
5	Apply Automated Decision Systems and basic concepts of Expert Systems.

Module-1: An Overview of Business Intelligence, Analytics, and Decision Support	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics **Practicals**: Work on a sample Exploratory Data Analysis (EDA) project using real-world business data (e.g., sales, customer churn).	**8**	**Understand CO1**
Module-2: Decision Making		
Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components. **Practicals**: Analyze a dataset and build a predictive model to forecast sales or customer churn.	**8**	**Apply CO2**
Module-3: Neural Networks and Sentiment Analysis		
Basic Concepts of Neural Networks, Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Speech Analytics. **Practicals:** Create a business dashboard (e.g., Sales Performance, Customer Segmentation) using Power BI or Tableau.	**8**	**Apply CO3**
Module-4: Model-Based Decision Making		
Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Decision Analysis with Decision Tables and Decision Trees. **Practicals:** Choose a domain-specific dataset and analyze it end-to-end with visual storytelling and strategic recommendations.	**8**	**Analyze CO4**
Module-5:		

Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Development of Expert Systems. **Practicals:** Develop a Rule-Based Expert System	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
24CSE1813.1	Understand Business Intelligence, Analytics and Decision Support.
24CSE1813.2	Identify the process for Decision making.
24CSE1813.3	Apply predictive modelling techniques and sentiment analysis.
24CSE1813.4	Analyze Decision modeling methods.
24CSE1813.4	Apply concepts of Expert systems.

Text Books
1. Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013
Reference Books
1. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017by Edward Mize.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Theory	Average of 3 tests	15
		AAT	10
	Practical	Weekly Assessment – 10 Marks	10
		IA test – 15 Marks	15
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VIII (Professional Elective – V)

Course Name: Privacy and Security in Online Social Media		**Course Code: 24CSE1815**
L: T: P: J	3: 0: 0: 0	**CIA Marks:** 50
Credits:	3	**SEA Marks:** 50
Hours/Week (Total)	40	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand Privacy Risks – Learn how personal data can be exposed or misused on social media platforms.
2	Explore Security Challenges – Identify common security threats such as phishing, impersonation, and data breaches.
3	Analyze User Behavior – Study how user actions impact privacy and security in online environments.
4	Examine Platform Policies – Evaluate how social media platforms handle privacy and data protection.

Pre-requisite: Familiarity with how platforms like Facebook, Twitter, Instagram, etc., work, Computer Networks, Fundamentals of Cybersecurity, Interest in Online Privacy and Ethics

Module-1: Introduction to Online Social Networks	**No. of Hours**	**Blooms CognitiveLevels with CO mapping**
Introduction to Online Social Networks: Introduction to Social Networks, From offline to Online Communities, Online Social Networks, Evolution of Online Social Networks, Analysis and Properties, Security Issues in Online Social Networks, Trust Management in Online Social Networks, Controlled Information Sharing in Online Social Networks, Identity Management in Online Social Networks, data collection from social networks, challenges, opportunities, and pitfalls in online social networks.	**8**	**Understand**
Module-2: Trust Management in Online Social Networks		
Trust and Policies, Trust and Reputation Systems, Trust in Online Social, Trust Properties, Trust Components, Social Trust and Social Capital, Trust Evaluation Models, Trust, credibility, and reputations in social systems; Online social media and Policing, Information privacy disclosure, revelation, and its effects in OSM and online social networks; Phishing in OSM & Identifying fraudulent entities in online social networks	**8**	**Understand**
Module-3: Controlled Information Sharing in Online Social Networks		
Access Control Models, Access Control in Online Social Networks, Relationship-Based Access Control, Privacy Settings in Commercial Online Social Networks, Existing Access Control Approaches	**8**	**Analyze**
Module-4: Identity Management in Online Social Networks		
Identity Management, Digital Identity, Identity Management Models: From Identity 1.0 to Identity 2.0, Identity Management in Online Social Networks, Identity as Self-Presentation, Identity thefts, Open Security Issues in Online Social Networks	**8**	**Apply**
Module-5: Case Study		
Privacy and security issues associated with various social media such as Facebook, Instagram, Twitter, LinkedIn etc	**8**	**Understand**

Course Outcomes: After completing the course, the students will be able to

24CSE1815.1	Understand working of online social networks
24CSE1815.2	Outline the privacy policies of online social media
24CSE1815.3	Analyze countermeasures to control information sharing in Online social networks.

24CSE1815.4	Apply knowledge of identity management in Online social networks
24CSE1815.5	Compare various privacy issues associated with popular social media.

Textbooks
1. Security and Privacy-Preserving in Social Networks, Editors: Chbeir, Richard, Al Bouna, Bechara (Eds.), Spinger, 2013. 2. Security and Trust in Online Social Networks, Barbara Carminati, Elena Ferrari, Marco Viviani, Morgan & Claypool publications. 3. Security and Privacy in Social Networks, Editors: Altshuler, Y., Elovici, Y., Cremers, A.B., Aharony, N., Pentland, A. (Eds.), Springer, 2013
Reference Books
1. Security and privacy preserving in social networks, Elie Raad & Richard Chbeir, Richard Chbeir & Bechara Al Bouna, 2013 2. Social Media Security: Leveraging Social Networking While Mitigating Risk, Michael Cross, 2013

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
	IA Test	3 IA tests - Each of 30 Marks - Average of 3 tests	25 Marks
	Assignment	Two assignments – one for 10 marks and another for 5 marks	15 Marks
	AAT	Oral /Online Quizzes, Presentations, Group discussions, Case studies and any other activity	10 Marks
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
	Theory Exam	5 questions to answer each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 = 100 M reduced to 50 M
		Total Marks	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.