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 Linear Algebra **Course Code: 23MAC131 (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. **Fundamentals of 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. First order linear recurrence relation, second order linear homogenous recurrence relation with constant coefficients. *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,7th Edition, Mc Graw Hill publication.
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

An Autonomous Institution under VTU
Department of Information Science and Engineering

Computer Organization			
SEMESTER–III			
Subject Code: 23ISE132	L:T:P:J: 3:0:0:0	CIE Marks:	50
Credits:	3	SEE Marks:	50
Total Number of Lecture Hours	40	SEE Duration:	3 Hours

Course objectives:

- To understand the basic sub systems of a computer, their organization, structure and operation.
- Illustrate the concept of programs as sequences of machine instructions.
- Teach the concepts of Memory system and cache memory.
- Cultivate clear thinking in performing Arithmetic, Multiplication, division and Floating-point number operations in computer.
- Describe the working of pipelining and multiprocessor computer architecture.

Module1: Introduction	**Teaching Hours**	**Blooms cognitive Levels**
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.	**8**	**Understand**
Module 2: Input / Output Organization		
Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, USB.	**8**	**Understand**
Module 3: Memory System		
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations.	**8**	**Analyze**
Module 4: MIPS Arithmetic operations		
MIPS Addressing for 32-Bit Immediates and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, Addition and Subtraction (MIPS), Multiplication and Division (MIPS).	**8**	**Apply**
Module 5: Pipelining and Multiprocessors		
Pipelining: Basic concepts, Data Hazards, Instruction hazards, Basic processing unit: some fundamental concepts, execution of complete instruction, multi-bus organization, The structure of general-purposes multiprocessors, **Parallel Computer Architecture:** Processor Architecture and Technology Trends, Flynn's Taxonomy of Parallel Architectures.	**8**	**Apply**

Course outcomes: The students should be able to:

- CO 1: Ability to understand the abstraction of various components of a computer.
- CO 2: Ability to understand the functions of different sub systems, such as processor, Input/output, and memory.
- CO 3 : Analyze the concepts of Memory system and cache memory.
- CO 4 : Apply Arithmetic, Multiplication and division operations in computer.
- CO 5: Apply the working of pipelining and multiprocessor computer architecture

Reference Books:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002.
2. Parallel Programming for Multicore and Cluster Systems, Thomas Rauber, Gudula Runger, 2nd Edition, Springer, 2013.
3. David A. Patterson and John L. Hennessey, “Computer organization and design, The Hardware/Software interface”, Morgan Kauffman / Elsevier, Fourth/Fifth edition, 2014.
4. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.

B.N.M. Institute of Technology

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Operating Systems

SEMESTER–III

Subject Code: 23ISE133	L:T:P:J: 3:0:0:0	CIA Marks:	50
Credits:	3	SEA Marks:	50
Total Number of Lecture Hours	40	SEA Duration:	3 Hours

Course Objectives:

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

Module1: Introduction to Operating System & Process Management	**Teaching Hours**	**Blooms cognitive Levels**
Fundamental Concepts of Operating System: Introduction to Operating systems, Operating system functions and services, historical evolution of operating systems, 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, Multilevel Feedback Queue Scheduling, Multi-processor scheduling.	**8**	**Apply**
Module2: 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**
Module3: Memory Management		
Memory Management: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation, virtual memory concept, demand paging, page replacement algorithms, thrashing, Disk Scheduling. **Solid State Drives**-SSD Architecture, Flash Controller,	**8**	**Apply**
Module4: UNIX file 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 path names. File related commands – cat, mv, rm, cp, wc and od commands. **Practical component**: Execution of UNIX Shell Commands	**8**	**Apply**
Module5: File attributes and Shell programming		
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.	8	**Analyze**

The shells interpretive cycle: Wild cards. Removing the special meanings of wild cards. Three standard files and redirection. **Connecting commands**: Pipe, grep, egrep. **Shell programming**: Ordinary and environment variables. Read and read-only commands. Command line arguments. 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. The here (<<) document. Simple shell program examples. **Practical component:** Execution of Wildcards & UNIX Shell Programs		

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

Reference Books:

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

Unix System Programming Using C++ - Terrence Chan, PHI, 1999.

Web links and Video Lectures:

1. https://academicearth.org/
2. https://archive.nptel.ac.in/courses/106/105/106105214/

B.N.M. Institute of Technology

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Department of Information Science and Engineering

Data Structures and its Applications

SEMESTER– III

Subject Code: 23ISE134	L:T:P:J: 3:0:2:0	CIE Marks:	50
Credits:	4	SEE Marks:	50
Total Number of Lecture Hours	50	SEE Duration:	3 Hours

Course objectives:

- Learn the fundamental data structures and identify data structuring strategies that are appropriate to a given contextual problem and able to design, develop, test and debug in C language considering appropriate data structure. Use and implement structures to obtain solutions.
- Illustrate and implement data types such as stack, queue and linked list and apply them for the given problem.
- Understand and distinguish the conceptual and applicative differences in trees, binary trees and binary search trees. Apply the correct tree for the given application.
- Create and use appropriate data structures in C programs for solving real life problems.

Module 1: Stacks and Queues	**Teaching Hours**	**Blooms cognitive Levels**
Data Structures: Classification (Primitive & Non-primitive), Operations,Pattern Matching Algorithms (Brute force, KMP) **Stacks:** Definition, Operations, Implementation using arrays, Applications of Stacks – Infix toPostfix Conversion and Postfix Expression Evaluation. **Queues:** Definition, Operations, Implementation, Applications, Circular Queue (Message queueusing Circular queue), Doubly Ended Queue, Priority Queue. **Practical session:** Tracing Exercises, Analysis Exercises, Exercises to Modify programs **Programs not limited to:** 1. Implement KMP pattern matching algorithm for a given main string and pattern 2. Implement Boyer-Moore pattern matching algorithm for a given main string and pattern 3. Program to implement stack operations (push, pop, and display) using static array and also on dynamic array and compare the performance 4. Program to convert infix expression into postfix. 5. Program to evaluate given postfix expression	**10**	**Apply**

6. Program to implement queue operations using static arrays and on dynamic arrays and compare the performance. 7. Program to implement circular queue operations using arrays and on dynamic arrays and compare the performance		
Module 2: Linked List		
Linked Lists: Definition, Create, Insert, Delete, Update, Traverse, and Position-based Operations, Concatenate, Merge, and Reverse Lists, Doubly Linked List Implementation and Operations, Circular Linked List Implementation and Operations, Applications of Lists (Polynomial addition). Implementation of stacks and queues using Linked List **Practical session:** Tracing Exercises, Analysis Exercises, Exercises to Modify programs **Programs not limited to:** 1 Program to create single linked list and implement its operations with and without header nodes I. Insert (front and rear end) ii. Delete. (Front and rear end) iii. Search. iv. Reverse. 2 Implement DLL as a stack and also as a queue 3 Create 2 CLL of sparse polynomials and perform addition on these 2 polynomials. Represent the resulting polynomial in a CLL 4 Implement multiple stacks and multiple queues in a singly linked list	**10**	**Apply**

Module 3: Trees		
Concept Learning: Trees: General Tree Representation, Traversals, Applications. **Binary Trees**: Definition, Properties, Traversals, Applications. **Binary Search Tree**: Definition, Implementation, Search, Insert, Delete operations. Building and Evaluating Binary Expression Tree. **Concept Learning Graphs:** Adjacency Lists, and Traversal of Graphs (BFS and DFS) **Practical session:** Tracing Exercises, Analysis Exercises, Exercises to Modify programs **Programs not limited to:** 1 Implement the following operations on Binary tree: - A. Count the number of nodes in the binary tree B. Count the leaf nodes C. Check if 2 trees are equal D. Perform Tree Traversals namely in-order, pre-order, post-order and level order.	**10**	**Apply**

2 Create a Binary search Tree for a set of integer values, perform deletion of a key and searching for a key 3 For a given input graph check whether the nodes are connected or not using BFS and DFS method 4 Create an expression tree to evaluate the given expression using binary tree		
Module 4: Advanced Trees & Hashing		
Concept Learning: Heap Tree: Definition, Implementation, Insert, Delete, Peek operations. **Hashing**: Hash Table, Hash Functions, Collision Handling by Open Addressing, Chaining. **Practical session:** Tracing Exercises, Analysis Exercises, Exercises to Modify programs. **Programs not limited to:** 1 Create a max heap and min heap of integers, display the values and perform deletion operations 2 Program to implement hashing with collision resolution	**10**	**Apply**
Module 5: File Structures		
File Structures: Primary Indexing, Secondary Indexing, B-Trees, Co sequential processing, K way merge. **Practical session:** Tracing Exercises, Analysis Exercises, Exercises to Modify programs. **Programs not limited to:** 1 Write a program to implement simple index on primary key for a file. Implement add (), search (), delete () using the index. 2 Write a program to read two lists of names and then match the names in the two lists using Consequential Match based on a single loop. Output the names common to both the lists. 3 Write a program to read k Lists of names and merge them using k-way merge algorithm with k = 8.	**10**	**Apply**

Course outcomes: The students should be able to:

CO1: Apply fundamental data structures viz., Lists, Stacks, Queues, Linked Lists, Binary Trees from first principles
CO2: Identify the use of appropriate data structures for a given problem
CO3: Design and implement solutions to basic practical problems using customized data structures
CO4: Apply the Advanced concepts like Heap & Hashing to solve problems.
CO5: Identify how applying file structures to various real-world scenarios can enhance problem-solving skills.

Reference Book:

1. Fundamentals of Data Structures in C -- by Horowitz, Sahni and Anderson-Freed (Silicon Press 2007).
2. Data Structures Using C, Reema Thareja, 1st Edition, 2011, Oxford Higher Education, ISBN-13: 978-0198099307 "Data Structures and Program Design in C", Robert Kruse, C L Tondo, Bruce Leung and ShashiMogalla, PHI, 2nd Edition, 2015.
3. Y. Langasm, M. J. Augenstein, A. M. Tenenbaum (2001) Data Structures Using C and C++, PrenticeHall India, New Delhi, India.
4. T. H. Cormen, C. E. Leiserson and R. L. Rivest (1990) Introduction to Algorithms, Third Edition, MITPress, MA.
5. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4th Revised edition; 2013,Addison-Wesley, ISBN-13: 978-8131714744

Web Links and Video Lectures:

1. https://www.geeksforgeeks.org/data-structures/
2. https://nptel.ac.in/courses/106102064

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Object Oriented Programming using Java
III Semester

Course Code: 23ISE135	**L:T:P:J 3:0:2:0**	**CIA Marks**	**50**
Credits	**04**	**SEA Marks**	**50**
Total Number of Contact Hours	**50**	**SEA Duration**	**03**

Course Learning Objectives: This course will enable students to:

- Show competence in the use of the Java programming language in the development of small to medium-sized application programs that demonstrate professionally acceptable coding and performance standard
- Understand the basic principles of the object-oriented programming
- Demonstrate an introductory understanding of graphical user interfaces, multithreaded programming, and event-driven programming.

Module – 1	**No. of hours**	**Blooms cognitive Levels**
Basics of Java: Features of Java, Byte Code and Java Virtual Machine, JDK, Data types, Operator, Control Statements – If , else, nested if, if-else ladders, Switch, while, do-while, for, for-each, break, continue. **Array and String:** Single and Multidimensional Array, String class, StringBuffer class, Operations on string, Command line argument, Use of Wrapper Class. **Classes, Objects and Methods:** Class, Object, Object reference, Constructor, Constructor Overloading, Method Overloading, Recursion, Passing and Returning object form Method, new operator, this and static keyword, finalize() method **Programs:** 1. Write a program to convert rupees to dollar. 60 rupees=1 dollar. 2. Write a program that calculate percentage marks of the student if marks of 6 subjects are given. 3. Write a program to enter two numbers and perform mathematical operations on them. 4. Write a program to find length of string and print second half of the string. 5. Write a program to accept a line and check how many consonants and vowels are there in line. 6. Write a program to count the number of words that start with capital letters. 7. Write a program to find that given number or string is palindrome or not. 8. Create a class which asks the user to enter a sentence, and it should display count of each vowel type in the sentence. The program	**12**	**Apply**

should continue till user enters a word "quit". Display the total count of each vowel for all sentences. 9. Write an interactive program to print a string entered in a pyramid form. 10. Write an interactive program to print a diamond shape. 11. Program to define class Box and constructors. Demonstrate constructors. 12. Program to define class Addition, methods and objects. Demonstrate method overloading to add 2 integers, 3 floating numbers and 2 strings.		
Module – 2		
Class and Objects (Contd.) Access control, modifiers, Nested class, Inner class, Anonymous inner class, Abstract class. **Inheritance:** Use of Inheritance, Inheriting Data members and Methods, constructor in inheritance, Multilevel Inheritance – method overriding Handle multilevel constructors – super keyword, Stop Inheritance - Final keywords, Dynamic method dispatch, Understanding of Java Object Class, **Package and Interfaces:** Use of Package, CLASSPATH, Import statement, Static import, Access control Creation and Implementation of an interface, Interface reference, Interface inheritance, Nesting Interfaces, variables in Interfaces, Comparison between Abstract Class and Interface **Programs:** 1. Program to define inheritance and show method overriding - Program to define base class Shapes, with methods and create derived classes Square, Triangle, Rectangle and Circle. Create objects and show method overriding for calculating area of Square, Triangle, Rectangle and Circle. 2. Create an Interface Stack with methods push(), pop() and show(). Create class IntStack which implements Stack. Demonstrate the working of this class. 3. Create an Interface Queue with methods insert(), delete() and display(). Create class StringQueue which implements Queue. Demonstrate the working of this class	10	**Apply**
Module – 3		
Exception Handling: Exception and Error, Use of try, catch, throw, throws and finally, Built in Exception, Custom exception, Throwable Class. **Multithreaded Programming**: Use of Multithread programming, Thread class and Runnable interface , Thread priority, Thread synchronization, Thread communication, Deadlock **Programs:** 1. Analyze how a programmer must handle an error when an invalid mobile number is entered (lesser than 10 digits or greater than 10 digits; with alphabets; starting with 0) is entered while taking the	**10**	**Apply**

details of a student. The Student class must contain the following: Name; USN; Branch and Mobile Number. Write a program using a custom exception type		

2. Create an exception called Non Int Result Exception, which is generated when the result of dividing two integer values produces a result with a fractional component. Non Int Result Exception has two fields that hold integer values; a constructor; and an override of the to String() method, allowing a friendlier description of the exception to be displayed using println(). 3. Write a JAVA program which creates two threads, one thread displays "JAVA" 10 times, and another thread displays "PROGRAMMING LANGUAGE" 15 times continuously? 4. Write a Java program that implements a multi-thread application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number and prints; third thread will print the value of cube of the number 5. Write a program that prints the Multiplication Table for numbers 2-10. At a time the tables must print completely for one number before printing for the next number 6. Create a Counter class with a private count instance variable and two methods. The first method: synchronized void increment() – tries to increment count by 1. If count is already at its maximum of 3, then it waits until count is less than 3 before incrementing it. The other method is synchronized void decrement() – attempts to decrement count by 1. If count already at a minimum of 0, then it waits until count is greater than 0 before decrementing it. Every time either method has to wait, it displays a statement as to why it is waiting. Also every time an increment or decrement occurs, the Counter displays a statement that says what occurred and shows count's new value. 7. Create a Bank class with withdrawal and deposit methods. Demonstrate the use of notify() and wait().		
Module – 4		
IO Programming: Introduction to Stream, Byte Stream, Character stream, Readers and Writers, File Class, File Input Stream, File Output Stream, Input Stream Reader **Swings:** Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing J Applet; J label and Image Icon; J Text Field; The Swing Buttons; J Tabbed pane; J Scroll Pane; JList; J Combo Box; JTable. **Programs:** 1. Create a class called Student. Write a student manager program to manipulate the student information from files by using File Input	**10**	**Apply**

Stream and File Output Stream 2. Refine the student manager program to manipulate the student information from files by using the Buffered Reader and Buffered Writer 3. Refine the student manager program to manipulate the student information from files by using the Data Input Stream and Data Output Stream. Assume suitable data **4.** Create a GUI for a business of your choice using swings. Demonstrate the use of Button, Radio Button, Combo box, List, Textfield etc.		

Module – 5		
Servlet : The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax. servlet Package; Reading Servlet Parameter; The Javax. servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects **Programs:** 1. Write Servlet application to print current date &time 2. Write Servlet application to demonstrate session tracking 3. Implement Program 1 using JSP 4. Implement Program 2 using JSP	**8**	**Apply**
Course Outcomes: After completing the course, the students will be able to		
CO 1**:**Understand object-oriented programming concepts and implement in java. CO 2**:**Comprehend building blocks of OOPs language, inheritance, package and interfaces. CO 3**:**Identify exception handling methods. CO 4**:**Implement multithreading in object oriented programs CO 5**:**Describe how servlets fit into Java-based web application architecture		
Reference Books : 1. The Complete Reference, Java 2 (Eleventh 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,McGrawhill 4. Core Java Volume-I Fundamentals Horstmann& Cornell, - Pearson Education. - Eleventh Edition 5. Head First Java: A Brain-Friendly Guide, 3rd Edition- Kathy Sierra, Bert Bates		

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An Autonomous Institution under VTU

Department of Information Science and Engineering

SEMESTER–III

Course Name: WEB TECHNOLOGYG

Course Code: 23ISE136

L:T:P:J	**0:0:2:2**	**CIA:**	**50**
Credit:	**02**	**SEA:**	**50**
Hours:	**25**	**SEA Duration:**	**3 HOURS**

Course Learning Objectives: The students will be able to

1. Learn about HTML, JavaScript
2. Learn about Scopes and Closures in java Script, develop a Server-side programming using java Script.
3. Develop a client-side Application using React Js

PART A

Module-1	**No. of Hours**	**Blooms cognitive Levels**
Introduction to HTML, what is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, HTML Elements, HTML5 Semantic Structure Elements. HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility.	5	Apply
Module-2		
JavaScript: What is JavaScript and What can it do? JavaScript Design Principles, where does JavaScript Go? Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Data types and variables, Operators, screen output and keyboard input, Control statements.	5	Apply
Module-3		
What is React? : Defining React, Why React? What problem does react Solve? React is not just another Framework, React Concept and Terminology.	5	Apply
Module-4		
The Core of React: React, React.createClass, React.Children.map, React.Children.forEach, React.Children.count, React.Children.only, React.createElement, React.cloneElement, React.DOM,, React.createFactory, React.render, React.renderToString, React.findDOMNode.	5	Apply
Module-5		
Discovering React Components, Understanding Component, Properties and Methods, Component Lifecycle and Rendering: render, getInitialState, getDefaultProps, Mixins, propTypes, statics, displayName, componentWillMount, componentDidMount, componentWillReceiveProps, should ComponentUpdate, componentWillUpdate, componentDidUpdate, componentWillUnmount.	5	Apply

React Elements, React Factories.		
PART –A (Programs) Not restricted to the list given		
1. Design a web page that shows your class timetable using HTML table tag. 2. Design a form which should accept the student data such as, USN, Name of the Student, Date of birth, Branch, Semester. After submitting the form, It should display confirmation message. 3. Write a JavaScript to design a simple calculator to perform the following operations: Sum, product, difference, and quotient. 4. Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format. 5.Develop and demonstrate a HTML5 file that includes JavaScript script that uses functions for the following problems: a. To check whether a string is palindrome or not b. Fibonacci Sequence using Recursion. 6. Create a student registration form for job application and validate the form fields using JavaScript. 7. Develop a JavaScript program to shuffle deck of cards. 8. Write a program using react for creating a ToDo list. 9. Develop an Quiz App using React. 10. Create an currency app using React		
PART - B (Mini - Project) Not restricted to the list given		
Develop a web application project using the languages and concepts learnt in exercises listed in part A with a good look and feel effects. You can use any web technologies and frameworks and databases. Sample Projects Include : 1. Food Ordering Website 2. Online Purchase Store 3. Search Engine etc. 4. College website 5. Banking application 6. Blood donation application 7. Gaming application 8. Library management system 9. Chat application 10. Tourism website	25	Apply

Course Outcomes: After completing the course, the students will be able to	
CO 1	Create web pages with various media contents using HTML5.
CO 2	Create a robust Client-side validation with java script
CO 3	Create an application using react js

Reference Books:

1. Programming the World Wide Web, 7th edition, Robert W. Sebesta , Pearson Education, ISBN- 9789332518827.
2. Introduction to React , by Cory Gackenheimer, Released September 2015, Publisher(s): Apress, ISBN: 9781484212455
3. Learning React: A Hands-On Guide to Building Web Applications Using React and Redux, Krupa Chinnathambi, (2nd Edition)

Web links and Video Lectures:

1. https://academicearth.org/
2. https://onlinecourses.nptel.ac.in/noc20_ee98/preview

BNM Institute of Technology

Syllabus for Softskills-1
SEMESTER – III

Subject Name	Softskills-1 (Soft skills for Industry & Quantitative Aptitude and Logical Reasoning)	**Weekly Continuous Assessment Marks (6 tests)**	Max 10 Min 4
Subject Code	23SFT	**Practice Tests for Internal Assessment Marks (6 tests)**	Max 15 Min 6
Number of Contact Hours/Week	2	**Final Assessment Marks (during 3rd test on Tab MCQ)**	Max 25 Min 10
Total Number of Contact Hours	24	**Credits**	1

1.Understanding Corporate Communication: (2hrs)	Define corporate communication and its importance. Identify key stakeholders in corporate. Understand workplace etiquette: communication tone, addressing colleagues, and handling conflicts. Resume Writing.
2.Cross Culture Sensitivity: (2hrs)	Knowledge, awareness and acceptance of other cultures/caste/creed. Being of oneness and understanding the work environment.
3. Effective Communication and Interpersonal Skills (2hrs)	Skills we use daily when we communicate and interact with other people, both individually and in groups. Active listening, right response and clear message. Conduct mock presentations on technical topics relevant to engineering.
4. Collaboration and Team Communication: (2hrs)	Participate in team-based activities and projects to practice collaboration. Understanding types of Leadership and inculcating leadership skills
5. Written Communication (2hrs)	Passage / Email writing Identify your goal. Before you write an email, ask yourself what you want the recipient to do after they've read it. Writing technical documentation and reviews
6. Goal Setting & Mind Mapping (2hrs)	Development of an action plan designed to motivate and guide a person or group toward a goal. Gives one's life direction and boosts your motivation and self-confidence. Developing career Action plans
7. Quantitative Aptitude - 1(6hrs)	**Speed Math** : Number System, Multiple and factors, Divisibility Rules HCF & LCM, Squares and Cubes, BODMAS & Tables, Approximation, Decimals, Fractions, Surds & Indices
	Profit & Loss - Concepts of SP, CP, Profit, Loss, Gain or Loss %. Marked Price & Discount problems, Successive Selling Tye, Discount
	Percentages – Percent to Decimal or Fraction Conversion, Inverse Case – Value From Percentage, relative Percentage, Successive Selling type, Dishonest Dealings, partnerships **Averages** - Understanding Averages, relevance, meaning, properties of average, deviation method, weighted average, & solving problems.
8. Logical Reasoning - 1 (6hrs)	**Logical Aptitude** – Syllogism, Venn diagram method, three statement syllogism, deductive and inductive reasoning, introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions.

Coding & Decoding – Letter Coding, Number coding, symbol coding, **Crypt arithmetic** – basic concepts, addition, subtraction, multiplication of coded alphabets, types of cryptarithmetic Concept of EJOTY, Opposite Letter, Reversing thealphabets. Jumbling of Letter, Finding Codes of Derivatives.
Image Analysis - Paper cutting & Folding, Mirror & Water Image, Cubes andDice, Analogy, Find the odd one out, Rule Detection. Cubes and dice
Series Completion - Basics of Next no, Missing no and Wrong no and problemson that. Solving various types of Letter series and understanding different types.
Odd Man Out - Following certain patterns and groups. Identifying the errors/odd one in the group.
Visual sequence, visual analogy and classification, single & multiple comparisons, linear sequencing
Logical Puzzles - K-level thinking, Arithmetic Puzzles and stick puzzles

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science and Engineering

SEMESTER–IV

Course: MICRO CONTROLLER AND EMBEDDED SYSTEM

CourseCode:23ISE142

L:T:P:J	**3:1:1:0**	**CIA:**	**50**
Credits:	**04**	**SEA:**	**50**
Hours:	**50**	**SEA Duration:**	**3 HOURS**

Course Learning Objectives: The students will be able to

1. Understand the fundamentals of ARM based systems, basic hardware components, selectionmethods and attributes of an embedded system.
2. ProgramARM7controller using the various instructions.
3. Identify the applicability of the embedded system.
4. Comprehend the real time operating system used for the embedded system Develop and testProgramusingARM7TDMI/LPC2148.
5. Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version ofEmbedded 'C' &Keil Uvision-4 tool/compiler.

Module-1	**No. of Hours**	**Blooms cognitiveLevels**
Microprocessors versus Microcontrollers, ARM7 Embedded Systems: The RISC design philosophy, The CISC 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.	10	Apply
Module-2		
Introduction to the ARM7 Instruction Set: Data Processing Instructions. Branch Instructions, Load-Store Instructions, Software Interrupt Instructions, Program Status Register Instructions, Loading Constants. Writing and Optimizing ARM Assembly Code: Writing Assembly code, Profiling and cycle counting, Instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs. List of programs: 1.Write a program to add an array of 16 bit numbers & store the 32 bit result in internal RAM 2. Write a program to find the square of a number (1to10) using look-up table. 3. Write a program to find the largest number in an array of 32 numbers. 4. Write a program to arrange a series of 32 bit numbers in ascending order. 5. Write a program to count the number of ones and zeros in two consecutivememory locations.	10	Apply

Module-3		
Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems. **Typical Embedded System**: Core of an Embedded System, Memory, Sensors and Actuators (LED, 7segment LED display, stepper motor, Keyboard, Push button switch), Communication Interface (on board Communication Interface), Embedded firmware, Other system components. List of programs: 6. Display "Hello World" message using Internal UART. 7. Interface a Stepper motor and rotate it in clock wise and anti-clock wise direction.	10	Apply
Module-4		
Characteristics and Quality Attributes of an Embedded Systems: Characteristics of an Embedded Systems, Quality Attributes of an Embedded Systems. **Embedded Systems-Application and Domain Specific**: Washing Machine-Application Specific Embedded System. **Hardware and Software Co-Design and Program Modelling**: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modelling Language(UML). List of programs: 8. Demonstrate the use of an external interrupt to toggle an LED On/Off. 9. Display the Hex digits 0 to F on a 7-segment LED interface, with anappropriate delay in between.	10	Apply
Module-5		
Real-Time Operating System (RTOS) based Embedded System Design: How to Choose an RTOS. **Integration and Testing of Embedded Hardware and Firmware**: Integration of Hardware and Firmware, Board Power Up.	10	Apply

Course Outcomes: After completing the course, the students will be able to	
CO 1	Describe the architectural features and instructions of ARM7 microcontroller
CO 2	Apply the knowledge gained for Programming ARM7 for different applications and InterfaceExternal devices and I/O with ARM7 microcontroller.
CO 3	Interpret the basic hardware components and their selection method based on theCharacteristics and attributes of an embedded system.
CO 4	Develop the hardware/software co-design and firmware design approaches.
CO 5	Demonstrate the need of real time operating system for embedded system applications
CO 6	Develop and test program using ARM7 TDMI/LPC2148

Reference Books:

1. Andrew N Sloss, Dominic Symes and Chris Wright, A R M system developers guide,Elsevier, Morgan Kaufman publishers, 2008 1st Edition.
2. Shibu K V, "Introduction to Embedded Systems", Tata Mc Graw Hill Education, PrivateLimited, 2nd Edition.

3. Raghunandan..G.H, Microcontroller (ARM) and Embedded System, Cengage learningPublication, 20191st edition.
4. The Insider‟s Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1stedition,2005.
5. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson,20151stedition.
6. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers,2nd Edition,2008

Web links and Video Lectures:

1. https://academicearth.org/
2. https://onlinecourses.nptel.ac.in/noc20_ee98/preview

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: IV

Course Name: Database Management System		**Course Code: 23ISE143**
L: T: P: J	3:0 :1:1	**CIA Marks:** 50
Credits:	4	**SEA Marks:** 50
Hours/Week (Total)	5	**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 and Instances, 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 – Relationship Sets – Roles and structural Constraints, Weak Entity Types. **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		
Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, various types of joins, division, example queries,converting the database specification in E/R notation to the relational schema **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)	**10**	**Apply CO2**

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 toreflect 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 and Schema Modification:** 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 onecustomer. 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, as well as the maximum salary and the average salary in this department.	**10**	**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, 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	
22CSE143.1	Understand the Database System Concepts along with Data Modeling Using the Entity-Relationship (ER) Model
22CSE143.2	Apply the concepts of relations on RDBMS, constraints, joints using relational algebra operators.
22CSE143.3	Apply Structured Query Language for database manipulation.
22CSE143.4	Analyze functional dependencies to normalize relations of relational database
22CSE143.5	Analyze transactions processing, schedules protocols, serializability issues, deadlocks in DBMS and concepts of NoSQL with its advantages

Reference 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

B.N.M. Institute of Technology

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Department of Information Science and Engineering

Design and Analysis of Algorithms
SEMESTER– IV

Subject Code: 23ISE144	L:T:P:J: 3:0:2:0	CIE Marks:	50
Credits:	4	SEE Marks:	50
Total Number of Lecture Hours	50	SEE Duration:	3 Hours

Course objectives:

- Analyze the asymptotic performance of algorithms.
- To understand the concept of designing an algorithm.
- Synthesize efficient algorithms in common engineering design situations.

Analyze the efficiency of programs based on time complexity.

Module 1	**Teaching Hours**	**Blooms Cognitive Levels**
Introduction: Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. **Practical Programs:** 1. Implement the following concepts: a. Linear Search b. To find the maximum and minimum from a given list of n elements using Brute Force Method. 2. There are 5 books in the shelf, find the number of ways to select 3 books from 5 books on the shelf using the NCR with recursion. 3. Find the next three terms of the sequence 15, 23, 38, 61, … Fibonacci series of the given number using recursion.	**10**	**Analyze**
Module 2		
Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching **Divide and Conquer**: General method, Binary search, Recurrence equation for divide and conquer, Finding the Maximum and Minimum, Merge sort, Quick sort, Strassen's matrix multiplication. Decrease and Conquer Approach: Topological Sort. **Practical Programs:** 1. Implement the Selection sort algorithm. 2. Implement Bubble sort algorithm. 3. Implement the Sequential Search algorithm. 4. Write a program to search a key in a given set of elements using Binary search	**10**	**Apply**

method and find the time required to find the key. 5. Write a program to find Maximum and Minimum using divide and conquer technique and find the time required to find the elements. 6. Sort a given set of elements using Merge Sort method and determine the time required sort the elements. Plot a graph of number of elements versus time taken. Specify the time efficiency class of this algorithm. 7. Sort a given set of elements using Quick Sort method and determine the time required sort the elements. Plot a graph of number of elements versus time taken. Specify the time efficiency class of this algorithm. 8. Implement Topological sort using source removal method find the time required to sort the elements.		
Module 3		
Greedy Method: General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm. Single source shortestpaths: Dijkstra's Algorithm. Optimal Tree problem: Huffman Trees and Codes. **Practical Programs:** 1. Implement Coin Changing problem method and find the time required. 2. Implement Job Sequence problem using Greedy method. 3. Implement Prim's algorithm and Find Minimum Cost Spanning Tree of a given connected undirected graph. 4. Implement Kruskal's algorithm and Find Minimum Cost Spanning Tree of a given connected undirected graph. 5. Implement Dijkstra's algorithm find shortest paths to other vertices from a given vertex in a weighted connected graph.	**10**	**Apply**
Module 4		
Dynamic Programming: General method with Examples, Multistage Graphs. Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem, Reliability design. **Practical Programs:** 1. Implement all-pairs shortest paths problem using Floyd's algorithm. 2. Implement all-pairs shortest paths problem using Warshal's algorithm. 3. Implement 0/1 Knapsack using Dynamic Programming. 4. Implementation of Bellman Ford Algorithm using a directed graph. 5. Implement Travelling Sales man problem using Dynamic Programming.	**10**	**Apply**
Module 5		
Backtracking: General method (T2:7.1), N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem: LC Branch and Bound solution, FIFO Branch and Bound solution. NP- Complete and NP-Hard problems: Basic concepts, nondeterministic algorithms, P, NP, NP-Complete and NP-Hard classes **Practical Programs:** 1. Implementation of N Queen Problem using Backtracking technique. 2. Implementation of SUM-SUBSET Problem.	**10**	**Analyze**

3. Design and implement to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using the backtracking principle. 4. Implementation Assignment Problem using Backtracking technique. 5. Implementation of Travelling Sales Man Problem using Branch and Bound method. 6. Implementation of Knapsack problem using Branch and Bound method.		

Course outcomes: The students should be able to:	
CO1	Apply and Analyze the asymptotic runtime complexity of algorithms by using mathematical relations that helps to identify them in specific instances
CO2	Apply and solve problems using brute force, divide and conquer techniques
CO3	Apply various problem-solving methodologies such as greedy, decrease and conquer to solve a given problem.
CO4	Apply the dynamic programming to estimate the computational complexity of different algorithms.
CO5	Apply and Analyze the efficient algorithm design approaches in a problem specific manner in terms of space and time complexity

Reference Books:

1. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017 .
2. Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014
3. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill, Indian Edition
4. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER
5. Andrew S Tanenbaum, Computer Networks, fifth edition, Pearson
6. Mayank Dave, Computer Networks, Second edition, Cengage Learning

Web Links:

https://www.cs.duke.edu/courses/fall08/cps230/Book.pdf.
https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf.

B.N.M. Institute of Technology

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Department of Information Science & Engineering

Semester: IV

Course: Robotic Process Automation

Course Code: 23ISE145

L:T:P:J	**0:0:2:2**	**CIA**	**: 50**
Credits:	**02**	**SEA**	**: 50**
Hours:	**24**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	To Understand the basic concepts and platforms of RPA.
2	To Describe the different types of variables and its Datatypes.
3	To Describe the various types of Sequence and Control flow.
4	To Apply various control techniques.
5	To Apply Screen Scraping and OCR in RPA along with Error Handling.

Descriptions (if any):

Prerequisite

- **CPU with 1.4GHz 32-bit is minimum requirement** and **recommended is Dual Core 1.8GHz 64-bit.**
- **4GB** is the **minimum requirement and 8GB** is the **recommended** RAM.
- **Windows 7 or above** is required **OS**, though recommended is **Windows 10.**

Part A

Module-1:	No. of hours	Blooms Cognitive Levels
RPA Foundations and Platforms: What is RPA, Components of RPA, RPA Platforms- About UiPath - The future of automation, Record and PIay, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder **DOWNLOADING AND INSTALLING UIPATH STUDIO.** On UiPath Installation, download the Community Cloud version. **REVERSING A STRING** **A Quick Guide To The Top RPA Tool:** Using Project Templates and UiPath Studio Components **"WELCOMING TO THE SESSION "** **Introduction to UiPath and its Components:** Using Types of Projects and Templates in UiPath and UiPath Components	**L: 04**	**Apply**
Module-2:		
Variables and Data Types-Variables and Scope, Collections, Data Types, Arguments, Purpose and use, File operation with step-by-step example-CSV/Excel	**L: 05**	**Apply**

A) Display a Message in Message Box directly **B) Display Message in a Message Box using Variables** C) **Assign Activity**: To assign a value to a variable. Example-Count Number of Files D) **Write CSV Activity**: To save the specified Data Table to a .csv file.		
Module-3:		
Sequence and Control Flow-Sequencing the workflow, Activities-Control flow, various types of loops and decision making-Step-by Step example using Sequence. **ACTIVITIES IN UIPATH** **If Activity:** Find whether a number is even/odd **For Each Activity:** Print Fibonacci Series **While Activity:** Print Numbers 1-10 **Do While Activity:** Print Numbers 1-10 **Switch Activity**: Sum of two numbers is even/odd	**L: 05**	**Apply**
Module-4:		
Taking Control of the Controls : Finding and attaching windows , Act on controls - mouse and keyboard activities **ACTIONS** **A) WINDOWS ACTIONS** To automate the action of getting the title of an active window. **B) MOUSE CLICKS** To automate the action of closing a notepad window. **C) KEYSTROKES** To automate the task of writing text into a notepad file.	**L: 05**	**Apply**
Module-5:		
Screen Scraping and OCR- Screen Scrapping, When to use OCR, Types of OCR available, How to use OCR, **WEB EXTRACTION-WEB SCRAPING OF GOOGLE CONTACTS-** Extract data from Google Contacts and store it in a file. **READ PDF WITH OCR ACTIVITY** Show the uses of optical character recognition to scan the images inside the PDF document and output all the text as a Variable **EMAIL ACTIVITIES** Read the emails and filter the emails with sender name, subject, and body of the email.	**L: 05**	**Apply**

PART – B (Mini projects)

The List of Possible Projects

1.**MOVING FILES FROM SOURCE FOLDER TO DESTINATION FOLDER**
Task: The aim is to automate the process of moving files from the source folder to the destination folder**.**

2. WEB AUTOMATION
Task: The aim is to scrape data from a website and store it in a .csv File.

3. EMAIL AUTOMATION
Task: The aim is to save the attachments of the top 30 emails which have a keyword in the subject line. The attachments will be stored in a particular folder.

4. EXCEL AUTOMATION
Task: The aim is to fill a google form from the data stored in a .csv file automatically.

5. PDF AUTOMATION
Task: The aim is to extract text and images from a PDF File and store the output in a Message Box/TextFile.

6. IMAGE & TEXT AUTOMATION
Task: Consider an application is running in a virtual environment. Now, once we enter the account number, amount, choose transaction type, a transaction ID is automatically generated.Our task is to, display the Transaction ID in a message box once the transaction is successfully completed

7. AUTOMATED CUSTOMER SUPPORT EMAILS (WITH INSTRUCTIONS)
Task: The aim is to send automated replies to emails that have particular text in their subject line. For example, If a subject line has the word 'refund,' your solution would send an automated reply to it accordingly.

8. TO FIND OUT WHETHER A NUMBER IS EVEN OR ODD.
Task: The aim is to find out whether a number is even or odd using the different components of UiPath Studio and Dashboard Of UiPath

9. EXTRACTING DATA FROM AN E-COMMERCE WEBSITE
Task: Is to design automation which reads the subject line of an email and performs a custom search. So,
For example, if my subject line says LG TV then, the designed automation must search for LG TVs' in Flipkart and extract the name, URL, and the price.

10. HOW TO AUTOMATE TASKS IN A VIRTUAL ENVIRONMENT?
Task: Automating Task on a Desktop Application:
Consider a scenario where you want to open a Notepad in the virtual environment and want to type something in it. How will you automate this task?

****Projects are not limited**

Course Outcomes:
After studying these laboratory programs using UIPath, students will be able to

1. To Understand the basic concepts and platforms of RPA.
2. To Describe the different types of variables and its Datatypes.
3. To Describe the various types of Sequence and Control flow.
4. To Apply various control techniques.
5. To Apply Screen Scraping and OCR in RPA along with Error Handling.

Text Books:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: 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

Web links

- https://www.uipath.com/rpa/robotic-process-automation
- https://www.uipath.com
- https://academy.uipath.in
- https://www.edureka.co/blog

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

SEMESTER – V

Course Name: Software Engineering Project Management and Finance

Course Code: 23ISE151

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

Course Learning Objectives:

This course will enable students to

- Understand fundamental software engineering concepts including software processes, requirements engineering, and professional ethics.
- Apply standard models and techniques such as UML, software design principles, testing strategies, agile methodologies, and project planning in real-world software development contexts.
- Analyze and manage software development projects with a focus on risk management, quality assurance, financial estimation, and performance evaluation using modern tools and metrics.

	Number of Hours	**Bloom's Level**
Module-1		
Introduction: Software Crisis, Need for Software Engineering. Professional Software Development, Software Engineering Ethics. Case Studies. **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 **Self-Study Component: Comparative Study, Research Paper Review**	**8**	**Apply**
Module-2		
System Models: Structural models, Behavioral models, UML modeling using StarUml tool. **Design and Implementation**: Introduction to RUP, Design Principles **Software Testing:** Development testing, Test-driven development, Release testing, User testing. **Self-Study Component: UML Modeling Exercise, Tool Exploration, Test Plan Creation**	**8**	**Apply**
Module-3		
Project management: Risk management, Managing People, Teamwork. **Project Planning:** Software pricing, Plan-driven development, Project scheduling: Estimation techniques, **Quality management:** Software quality, Reviews and inspections, Software measurement and metrics, Software standards	**8**	**Apply**

Self-Study Component: Case Study Analysis, Estimation Practice, Metric Evaluation		
Module-4		
Agile Software Development: Coping with Change, The Agile Manifesto: Values and Principles. Agile methods: SCRUM (Ref —The SCRUM Primer, Ver 20.) and Extreme Programming. Plan-driven and agile development. Agile project management, Scaling agile methods. **Self-Study Component: Agile vs. Plan-driven Essay, SCRUM Simulation, XP Practice.**	**8**	**Apply**

Module-5		
How to Manage Project Finances-Cost estimating: Work Breakdown Structure, Cost budgeting: Cost Aggregation, Reserve Analysis, Parametric estimating, Infrastructure and overheads, Cost control: Change Control, Resource Management **Performance Measurement and Analysis-** Cost Variance, Earned Value, Schedule Variance, Cost Performance Index, Schedule Performance Index**.** Forecasting, Introduction of Tools to manage project Finances- TouchBase Project Financials **Self-Study Component: Budget Planning Exercise, Performance Dashboard, Tool Demo Report.**	**8**	**Apply**

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

1. Describe the software engineering principles, software development life cycles, requirement engineering processes, and ethical responsibilities of software professionals.
2. Implement design models using UML tools, conduct software testing, adopt agile practices, and plan software projects using appropriate development and scheduling techniques.
3. Analyze software quality metrics, estimate costs using standard techniques, and evaluate project performance using variance analysis and financial management tools.

Reference Books:

1. *Software Engineering* by Ian Sommerville, published by Pearson Education, is available in its 9th Edition released in 2012.
2. *Software Engineering: A Practitioner's Approach* by Roger S. Pressman is published by Tata McGraw-Hill and is available in its 7th Edition.
3. *An Integrated Approach to Software Engineering* by Pankaj Jalote is published by Wiley India; the specific edition and year were not mentioned.
4. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, published by the Project Management Institute, is now available in its 7th Edition, released in August 2021.

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: V

Course Name: Automata Theory and Computability

Course Code: 23ISE152

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	**Introduce the fundamental concepts** of automata theory, formal languages, and computational models such as finite automata, pushdown automata, and Turing machines.
2	**Design** grammars and recognizers for various classes of formal languages, and to analyze their properties and relationships using formal mathematical tools.
3	Develop the ability to evaluate the decidability and complexity of computational problems, and to prove key theoretical results in automata and computation theory.

Module-1: Introduction to the Theory of Computation:	**No. of hours**	**Blooms cognitive Levels**
Three Basic Concepts: Languages, Grammars and Automata, Some Applications. **Finite Automata:** Deterministic Finite Accepters, Deterministic Accepters and Transition Graphs, Languages and DFA's Regular Languages, Nondeterministic Finite Accepters: Definition of a Nondeterministic Accepter, Why Nondeterminism ? **Equivalence of Deterministic and Nondeterministic Finite Accepters**	**8**	**Understand**
Module-2: Regular Languages and Regular Grammars		
Regular Expressions: Formal Definition of a Regular Expression, Languages Associated with Regular Expressions, Connection Between RegularExpressions and Regular Languages, Regular Expressions Denote Regular Languages, Regular Expressions for Regular Languages, **Regular Expressions for Describing Simple Patterns.** Properties of Regular Languages: Closure Properties of Regular Languages Closure under Simple Set Operations, **Closure under Other Operations,** Identifying Non-Regular Languages, Using the Pigeonhole Principle A Pumping Lemma.	**8**	**Apply**
Module-3: Context-Free Languages:		
Context-Free Grammars, Examples of Context-Free LanguagesLeftmost and Rightmost Derivations, Derivation Trees, Relation Between Sentential Forms and Derivation Trees, Parsing and Ambiguity, **Parsing and Membership, Ambiguity in Grammars and Languages,** Simplification of Context-Free Grammars and Normal Forms: Methods for Transforming Grammars, A Useful Substitution Rule, Removing Useless Productions, Removing λ-Productions, Removing Unit-Productions, Two Important Normal Forms, Chomsky Normal Form, Definition of Greibach Normal Form.	**8**	**Apply**

Module-4: Pushdown Automata		
Nondeterministic Pushdown Automata: Definition of a Pushdown Automaton, The Language Accepted by a Pushdown Automaton, Pushdown Automata and Context-Free Languages: Pushdown Automata for Context-Free Languages, Context-Free Grammars for Pushdown Automata, A Pumping Lemma For Context-Free Language	**8**	**Apply**

Module-5: Turing Machines and Undecidability		
Turing Machines: The Standard Turing Machine, Turing Machines as Language Accepters, Turing Machine with more complex storage: Multitape Turing Machine, Multidimensional Turing Machine, Nondeterministic Turing Machine, Universal Turing Machine, Turing Thesis, Linear Bounded Automata. Hierarchy of Formal Languages and Automata: Recursive and Recursively Enumerable Languages, the Chomsky Hierarchy. **Limits of Algorithmic Computation: Some Problems that cannot be solved by Turing, Undecidable Problem for Recursively Enumerable Languages**.	**8**	**Analyze**

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

CO1: Understand the fundamental concepts of formal languages, grammar, finite automata, and Turing machines, and describe their role in recognizing different classes of languages.
CO2: Construct deterministic and nondeterministic automata, formulate regular expressions, grammar, and pushdown automata for given language descriptions, and implement Turing machines for specific language recognition tasks.
CO3: Analyze and differentiate between language classes and computational models and examine the limits of computation through undecidability and the Chomsky hierarchy.

Reference Books:

1. *An Introduction to Formal Languages and Automata* by Peter Linz, 7th Edition, published by Jones & Bartlett Learning in 2022.
2. *Introduction to Automata Theory, Languages, and Computation* by John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, 3rd Edition, published by Pearson Education in 2006.
3. *Introduction to the Theory of Computation* by Michael Sipser, 3rd Edition, published by Cengage Learning in 2012.
4. *Introduction to Languages and the Theory of Computation* by John C. Martin, 4th Edition, published by McGraw-Hill Education in 2010.
5. *Formal Languages and Automata Theory* by Basavaraj S. Anami and Karibasappa K. G., published by Wiley India in 2012.
6. *Formal Languages and Automata Theory* by C. K. Nagpal, published by Oxford University Press in 2012.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/106/106/106106049/
2. https://archive.nptel.ac.in/courses/111/103/111103016/
3. https://www.csa.iisc.ac.in/~dee`pakd/atc-2021/

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science and Engineering

Semester: V

Course Name: Data Science using Python
Course Code: 23ISE153

L:T:P:J	**2:2:2:0**	**CIA : 50**
Credits:	**04**	**SEA : 50**
Hours:	**50**	**SEA Duration : 03 Hours**

Course Learning Objectives: The students will be able to

1	**To introduce** the fundamentals of Python programming and essential data science libraries for performing data manipulation, analysis, and visualization.
2	**To develop** an understanding of descriptive statistics, data preparation, and exploratory data analysis techniques for gaining insights from data.
3	**To enable** students to implement supervised learning models and understand concepts like model validation, learning curves, and performance evaluation.
4	**To familiarize** students with regression and clustering techniques, including their application to real-world datasets and evaluation using statistical metrics.
5	**To provide** knowledge about recommender systems, including how to model user preferences and evaluate the effectiveness of recommendations.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction, Toolboxes: Python, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting. Program: 1,2,3	**10**	**Understand**
Module-2:		
Descriptive statistics, data preparation. **Exploratory Data Analysis data summarization, data distribution,** Outlier Treatment Programs: 4,5	**10**	**Apply**
Module-3:		
Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples Programs: 6,7	**10**	**Apply**
Module-4:		
Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Logistic Regression. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study. Programs: 8,9,10	**10**	**Apply**

Module-5:		
Recommender Systems: Introduction, How do recommender system works?, Modelling user preferences, **Evaluating recommenders, Practical case**. Programs: 11	**10**	**Apply**

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

CO1: Explain the foundational concepts of data science including data manipulation techniques, descriptive statistics, supervised and unsupervised learning algorithms, and recommender systems, along with their applications using appropriate Python libraries and tools.

CO2: Apply data manipulation techniques, exploratory data analysis, and statistical methods using Python to prepare, clean, and visualize datasets for machine learning tasks and predictive modeling.

CO3: Implement supervised and unsupervised learning algorithms including classification, regression, clustering, and recommender systems using Python libraries to solve real-world data science problems.

CO4: Analyze complex datasets by integrating data operations, statistical methods, machine learning models, regression techniques, and recommender systems to evaluate performance, identify insights, and support data-driven decision making.

Reference Books:

1. **Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications** by Laura Igual and Santi Seguí, published by Springer in 2024.
2. **Doing Data Science: Straight Talk from the Frontline** by Cathy O'Neil and Rachel Schutt, published by O'Reilly Media in 2013.
3. **The Data Visualization Workshop: A Self-Paced, Practical Approach to Transforming Your Complex Data into Compelling, Captivating Graphics** by Mario Döbler and Tim Großmann, 1st Edition, published by Packt Publishing in 2020.
4. **Mining of Massive Datasets** by Jure Leskovec, Anand Rajaraman, and Jeffrey D. Ullman, 3rd Edition, published by Cambridge University Press in 2020.
5. **Data Science from Scratch: First Principles with Python** by Joel Grus, 2nd Edition, published by O'Reilly Media in 2019.
6. **Data Visualisation: A Handbook for Data Driven Design** by Andy Kirk, 3rd Edition, published by SAGE Publications in 2024.

Web links and Video Lectures:

1. https://www.knowledgehut.com/blog/data-science/eda-data-science
2. https://towardsdatascience.com/data-exploration-understanding-and-visualization-72657f5eac41
3. https://matplotlib.org/

List of Exercises

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.Write a python program to read CSV file.
2. Demonstrate Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data
3. Using the following data, build a model/function that can tell us the prices of the homes with 3300 sq.ft. and 5000 sq.ft using linear regression, and also plot the above data as a scatter plot.
4. Plot Mean and Standard Deviation in Pandas.
5. Suppose there are 100 students in the class and in one of the mathematics tests the average marks scored by the students in the subject is 78 and the standard deviation is 25. The marks of the student follow Normal probability distribution. Write a code to find
    a. Percentage of Students who got less than 60 marks
    b. Percentage of Students who have scored More than 70
    c. Percentage of Students who have scored More than 75 and less than 85.
6. Predict if cancer is Benign or malignant. Using historical data about patients diagnosed with cancer enables doctors to differentiate malignant cases and benign ones are given independent attributes using SVM.
7. Implement random forest classifier on iris data set to classify the type of flower.
8. A linear regression line has an equation of the form Y = a + bX, where X is the explanatory variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value of y when x = 0). Write a Python program to describe linear regression.
9. Implement k-means algorithm.
10. Demonstrate how polynomial regression can be implemented.
11. Build a simple recommendation system.

Area	Price
2600	550000
3000	565000
3200	610000
3600	680000
4000	725000

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: V

Course: COMPUTER NETWORKS

Course Code: 23ISE154

L:T:P:J	**2:2:2:0**	**CIA**	**: 50**
Credits:	**04**	**SEA**	**: 50**
Hours:	**50**	**SEA Duration**	**: 03 Hours**

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 Medium Access Control protocols for reliable and noisy channels.
3	Expose wireless and wired LANs, Logical addressing.
4	Discuss transport layer services and understand UDP and TCP protocols.
5	Demonstration of application layer protocols

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model. **Introduction to Physical Layer**: Date Rate Limits, Performance Digital to Digital Conversion- Line coding: polar, unipolar, Block coding: 4B/5,Switching – Circuit switching, packet switching.	**10**	**Understand**
Module-2:		
Error Detection and Correction: Introduction, Block coding, Cyclic codes **Data Link Layer:** Data Link Control –DLC services: Framing, Flow and Error Control, Data link layer protocols: HDLC, Point to Point Protocol. Media Access Control – Random Access: CSMA/CD, CSMA/CA, Controlled Access, Channelization.	**10**	**Understand**
Module-3:		
Network Layer:IPV4Addresses:0 Address space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT). IPv6 Addresses, Routing Algorithms: Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm.	**10**	**Apply**
Module-4:		
Transport layer: Multiplexing and Demultiplexing, Connectionless Transport UDP: UDP Segment Structure, UDP Checksum, Connection-Oriented Transport-TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Flow Control, TCP Connection Management, TCP congestion control.	**10**	**Apply**

Module-5:		
Application Layer: The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, User-Server Interaction Cookies, Web Caching, The Conditional GET. File Transfer- FTP: FTP Commands and Replies, Electronic Mail in the Internet: SMTP, Comparison with HTTP, Mail Access Protocols. DNS—The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages,	**10**	**Analyze**

Course Outcomes: After completing the course, the students will be able to		
CO 1:	Understand the fundamentals of digital communication, switching , Framing and Principles of Application layer	
CO 2:	Infer error detection and correction mechanisms and Compare and contrast data link layer Protocols and basics of transport layer	
CO 3:	Classify wired and wireless network, IP and Routing Algorithms in network layer.	
CO 4:	Recognize transport layer services and infer UDP and TCP protocols.	
CO 5:	Identify Cyclic codes,services of application layer protocols.	

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.

Reference Books:

1. Data and Computer Communication, William Stallings, 10th Edition, Pearson Education, 2013.
2. Introduction to Data Communications and Networking – Wayne Tomasi, Pearson Education, 5thEdition, 2011.
3. Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
4. Tanenbaum: Computer Networks, 5thEdition, Pearson Education/PHI, 2010.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/106/105/106105183/
2. https://www.wireshark.org/docs/wsug_html_chunked/
3. https://www.softwaretestinghelp.com/computer-networking-basics/
4. https://ns3tutorial.com/ns2-ns3/

List of Exercises

Possible list of practical programs:

Implement the following in C/C++/Java.

1. Write a program for error detecting code using CRC-CCITT (16- bits).
2. Write a program to find the shortest path between vertices using bellman-ford algorithm
3. Write a program for congestion control using leaky bucket

algorithm. Analyze the following in Wireshark.

1. TCP
2. UDP
3. HTTP
4. FTP
5. DNS Server
6. DHCP

Implement the following in NS3 or any other suitable simulator.

1. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
2. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.

B.N.M. Institute of Technology

An Autonomous Institution under VTU
Department of Information Science & Engineering
Semester: V

Course Name: Computer Graphics
Course Code:23ISE155

L:T:P:J	**0:0:2:2**	**CIA:**	**50**
Credits:	**02**	**SEA:**	**50**
Hours:	**25**	**SEA Duration:**	**3 HOURS**

Course Learning Objectives: The students will be able to

1. Understand the basic architecture and applications of computer graphics and the structure of OpenGL programs.
2. Apply 2D geometric transformations and clipping algorithms to graphical objects in a raster environment.
3. Apply 3D geometric transformations and model basic 3D objects such as colored cubes using color representations.
4. Analyze interactive input mechanisms and program event-driven interfaces using menus and motion events.
5. Analyze and implement animation techniques for images and objects using OpenGL features like texture mapping.

Module-1:	**No. of Hours**	**Blooms cognitive Levels**
Introduction: Application of Computer Graphics, Architecture. Graphics Programing: Introduction to OpenGl, The OpenGl API, Primitives and Attributes, Viewing, The Gasket Program. **Self-Study Component: Explore OpenGL Setup, Study Real-Time Applications of Computer Graphics, Implement the Gasket Program**	5	Apply
Module-2:		
2D Transformations: Basic Transformations-Translation, Scaling, Rotation. Clipping in Raster World: Rectangular Clipping Windows. **Self-Study Component: Visualize 2D Transformations, Compare Clipping Algorithms, Practice Coordinate Geometry.**	5	Apply
Module-3:		
Three Dimensional Geometric Transformations: Translation, Scaling, Rotation. Modelling a Colored Cube, Color Representation. **Self-Study Component: Build and Rotate a 3D Cube, Study Color Models, Watch a 3D Modeling Tutorial.**	5	Apply
Module-4:		
Input and Interaction: Interaction, Programming Event Driven Input, Menus, Motion Event. **Self-Study Component: Menu Programming Practice, Learn About Event-Driven Programming, Motion Event Demo.**	5	Apply
Module-5:		
Animation Technique: Animation of an Image (Using Texture Mapping Technique), Animation of an object. **Self-Study Component: Texture Mapping Demo, Basic Object Animation, Explore Animation in Games/Movies**	5	Apply

Course Outcomes: After completing the course, the students will be able to	
CO 1	Explain the applications of computer graphics and describe the architecture and components of the graphics pipeline.
CO 2	Apply 2D and 3D geometric transformations (translation, scaling, rotation) to graphical objects using OpenGL.
CO 3	Implement primitives, attributes, and clipping operations in raster-based environments using graphics programming techniques.
CO 4	Analyze and program user interaction mechanisms such as menus, motion events, and event-driven inputs in graphics applications.
CO 5	Design and animate graphical objects using texture mapping and basic animation techniques in OpenGL.

Reference Books:

1. Meenakshi M. Raikar, Computer Graphics with OpenGL, CENGAGE, 2019
2. Donald D Hearn, M Pauline Baker and WarrenCarithers: Computer Graphics with OpenGL 4th Edition, Pearson, 2014
3. S. Sridhar, Digital Image Processing, second edition, Oxford University press 2016.An Integrated Approach to Software Engineering Pankaj Jalote Wiley India.
4. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008
5. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

Programs:

1. Program to display an empty Window.
2. Program to display a triangle.
3. Program to generate the 2D Sierpinski gasket using random points.
4. Create and rotate a triangle about the origin and a fixed point.
5. Program to implement Liang-Barsky Line Clipping Algorithm.
6. Draw a color cube and spin it using Open GL transformation matrices.
7. Program to display a sphere, with keyboard interaction.
8. Program to display a pop-up menu to change the color of object square.
9. Program to animate an image.

Project List:

2DGame
3D House
Aeroplane Crash
Archery
Bike Simulation
Bull's Eye
Car Parking
Catch Me
Taj Mahal
Maze Game
Walking Robot
Flowing Fountain

B.N.M. Institute of Technology

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Department of Information Science & Engineering

Semester: V

Course Name: Introduction to Web Technologies

Course Code: 23ISE1561

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Hours:	**40**	**SEA Duration : 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the fundamentals of internet and web Technology.
2	Identify the Semantic Structure of HTML and CSS.
3	Develop forms, tables using HTML, CSS and JavaScript
4	Apply Java script functions and arrays to develop an application.
5	Apply event handling and validation using javascript

Module-1	**No. of hours**	**Blooms Cognitive Levels**
Fundamentals: A brief introduction to Internet, Origins, What the Internet Is, Internet Protocol Addresses, Domain Names, The World Wide Web, Origins, Web or Internet, Web browsers, Web servers, Web Server Operations, General Server Characteristics, Apache, IIS, Uniform Resource Locators, URL Formats, URL Paths, Multipurpose Internet Mail Extensions, Type Specification, Experimental Documental Types, Hypertext Transfer Protocol, The Request Phase, The Response Phase.	**08**	**Understand**
Module-2		
Introduction to HTML, what is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, what is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling. Programs: 1,2	**08**	**Apply**
Module-3		
HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility. Programs: 3,4	**08**	**Apply**
Module-4		
JavaScript: What is JavaScript and What can it do? JavaScript Design Principles, where does JavaScript Go? Syntax, JavaScript Objects, The Document Object Model (DOM), Javascript Data types and variables, Operators, screen output and keyboard input. Programs: 5,6,7	**08**	**Apply**
Module-5		
Control statements Javascript Functions, Arrays, Array Methods,Strings, String Methods, Regular expressions, JavaScript Events,Validating form Input. Programs: 8,9,10	**08**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the fundamentals of internet and web Technology
CO 2:	Identify the Semantic Structure of HTML and CSS
CO 3:	Develop forms, tables using HTML, CSS and JavaScript
CO 4:	Apply Java script functions and arrays to develop an application.
CO 5:	Apply event handling and validation using javascript

Reference Books:

1. **Programming the World Wide Web** by Robert W. Sebesta, 8th Edition, published by Pearson Education in 2015.
2. **Fundamentals of Web Development** by Randy Connolly and Ricardo Hoar, 3rd Edition, published by Pearson Education in 2022.
3. **Web Technologies** by Uttam Kumar Roy, 1st Edition, published by Oxford University Press in 2011.
4. **Web Programming: Building Internet Applications** by Chris Bates, 3rd Edition, published by Wiley in 2006.
5. **PHP: The Complete Reference** by Steven Holzner, 1st Edition, published by McGraw-Hill in 2008.

Web links and Video Lectures:

1. https://www.w3schools.com/
2. https://www.tutorialspoint.com/web_developers_guide/
3. https://archive.nptel.ac.in/courses/106/105/106105084/
4. https://onlinecourses.swayam2.ac.in/aic20_sp32/
5. https://www.nptelvideos.com/php/php_video_tutorials.php

List of Programs (Not Restricted)

1. Design a web page for restaurant application with an attractive background color, text color, an image, font. (Make use of External, Internal and Inline CSS and all selectors).
2. Design a calendar of December 2022 using HTML and CSS.
3. Design a web page that shows your class timetable using HTML table tag.
4. Design a form which should accept the student data such as, USN, Name of the Student, Date of birth, Branch, Semester. After submitting the form, It should display confirmation message.
5. Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format.
6. Create a variable called z, assign x + y to it, and display the result in an alert box.
7. Write a javascript to demonstrate all operators in javascript.
8. Write a function that takes one argument and returns the factorial of that number.
9. Write a javascript to demonstrate all string methods.
10. Write a javascript to validate the form created in program 4 and display proper error messages.

B.N.M. Institute of Technology

An Autonomous Institution under VTU
Department of Information Science & Engineering
Semester: V

Course Name: Software Engineering
Course Code: 23ISE1562

L:T:P:J	**3:0:0:0**	**CIA:50**
Credits:	**03**	**SEA:50**
Hours:	**40**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	Outline software engineering principles and activities involved in building large software programs.
2	Describe the process of requirements gathering, requirements classification, requirements specification and requirements validation.
3	Apply estimation techniques, schedule project activities and compute pricing by identifying software quality parameters and quantify software using measurements and metrics.

Module-1:	**No. of hour**	**Blooms cognitive Levels**
Introduction: FAQs about software engineering, Professional and ethical responsibility, Software Processes: Software Process models, Process Iteration, Process Activities, Software requirements: Functional and Non-functional requirements, User requirements, System requirements, Interface specification, The software requirements document.	**08**	**Understand**
Module-2:		
Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. **System models:** Context models, Behavioural models, Data models, Object models, Structured methods.	**08**	**Apply**
Module-3:		
Architectural Design: Architectural Design Decisions, System organization, Modular Decomposition styles, Control styles, Object oriented design: Objects and Object Classes, An object oriented design process, Design evolution.	**08**	**Analyze**
Module-4:		
Project Management Concepts: The Management Spectrum, People, Product, Process and Project, The W5HH principle, Critical practices,	**08**	**Apply**
Module-5:		
Project Management Concepts: Estimation for Software Projects: Software Project estimation, DecompositionTechniques, Empirical Estimation models. **DevOps practices: Introduction to DevOps, Collaboration and Communication, Continuous Integration (CI), Continuous Delivery (CD).**	**08**	**Analyze**

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

CO1: Explain the fundamental concepts of software engineering, including software processes, requirements, and system models.

CO2: Apply architectural design principles and object-oriented techniques to design and evolve software systems.

CO3: Analyze project management strategies, estimation techniques, and DevOps practices in the context of software project planning and delivery.

Reference Books:

1. **Software Engineering by Ian Sommerville, 10th Edition, published by Pearson Education in 2015.**
2. **Software Engineering: A Practitioner's Approach by Roger S. Pressman and Bruce R. Maxim, 9th Edition, published by McGraw-Hill Education in 2020**
3. **Software Engineering: Theory and Practice by Shari Lawrence Pfleeger and Joanne M. Atlee, 4th Edition, published by Pearson Education in 2009.**
4. **Software Engineering: Principles and Practice by Waman S. Jawadekar, published by Tata McGraw-Hill in 2004.**

Web links and Video Lectures:

1. **"Fundamentals of Software Engineering" Rajib Mall 3rd edition https://www.docdroid.net/gzKpqAI/softwareengineering-rajibmall.pdf**
2. **"An Integrated approach to Software Engineering" Pankaj Jalote. 3rd edition springer https://www.academia.edu/4660479/an_integral_approach_to_software_engineering**

B.N.M. Institute of Technology

An Autonomous Institution under VTU
Department of Information Science & Engineering
Semester: V

Course Name: Design and Analysis of Algorithms
Course Code: 23ISE1563

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Explain various computational problem-solving techniques.
2	Apply appropriate method to solve a given problem.
3	Describe various methods of algorithm analysis.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: Basics of Algorithms: What is an Algorithm? Properties of an Algorithm, Fundamentals of Algorithmic Problem Solving, Asymptotic Notations, Standard Notations and Common Functions, Comparing functions, Mathematical Analysis of Non-recursive and Recursive Algorithms, Problems on Asymptotic Notation. **Lab Programs** 1. Search a key element in a given set of elements using Linear Search method and determine the time required to search the element. 2. There are 5 books in the shelf, find the number of ways to select 3 books from 5 books on the shelf using the $^{N}C_{R}$ with recursion. 3. Find the next three terms of the sequence 15, 23, 38, 61, … Fibonacci series of the given number using recursion.	**08**	**Understand**
Module-2:		
Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching. **Divide and Conquer:** Recurrence equation for divide and conquer, Binary Search, Merge sort, Quick sort, Analysis of Quicksort. **Lab Programs** 1. Demonstrate through a program how a sequence of characters is taken and checked for the possibility of the presence of the requiredstring. If the possibility is found then, character matching is performed else no using Rabin Karp method. 2. Sort a given set of elements using Quick Sort method and determinethe time required sort the elements. Plot a graph of number of elements versus time taken. Specify the time efficiency class of thisalgorithm. 3. Sort a given set of elements using Merge Sort method and determinethe time required sort the elements. Plot a graph of number of elements versus time taken. Specify the time efficiency class of this algorithm.	**08**	**Apply**

Module-3:		
Greedy Technique: Fractional Knapsack Problem, Prim's Algorithm,Kruskal's Algorithm, Dijkstra's Algorithm, Huffman codes. **Lab Programs** 1. We want to build a new plant in the following network, nodes areplaces and links represent costs to send energy from one place to another based on Dijkstra's algorithm, proposes a method to find the best place to build the plant, and then solve the problem with your method. 1. Give a list of the connections the bank should establish in order to minimize their total cost, subject to this constraint. Find the minimum cost spanning tree of a given connected undirected graph using Prim's or Kruskal's algorithm. 2. Construct a Huffman tree for the given code using data structures like priority queues, stacks, and trees to design a compression and decompression logic.	**08**	**Apply**

Module-4:		
Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting **Lab Programs** 1. Sort a given set of elements using Insertion Sort method and determine the time required sort the elements. 2. Print all the nodes reachable from a given starting node in a digraph using BFS. Give the trace of this algorithm where one can move from node u to node v only if there's an edge from u to v and find the BFS / DFS traversal of the graph starting from the 0^{th} vertex, from left to right according to the graph. Also, you should only take nodes directly or indirectly connected from Node 0 in consideration. 3. Design a program to print topological sorting of a Directed Acyclic Graph(DAG)	**08**	**Apply**
Module-5:		
Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, 0/1 Knapsack Problem, Travelling Salesman Problem, Multistage Graphs, Reliability design. **Lab Programs** 1. Implement 0/1 Knapsack problem using dynamic programming. Give the trace of this algorithm. 2. Suppose in a network of cities, you are interested in finding shortest paths between all cities. Design a 'C' program to implement this using floyd's algorithm. Find its time and space complexity. 3. Suppose a salesperson want to visit n cities to promote the sales of a product. Find an optimal route / way to visit all the cities and reach back the same city using dynamic programming.	**08**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand and explore the asymptotic runtime complexity of algorithms by using mathematical relations that helps to identify them in specific instances.
CO 2:	Apply and solve problems using brute force, divide and conquer techniques
CO 3:	Apply problem solving methodologies such as greedy to solve a given problem
CO 4:	Apply problem solving methodologies such as decrease and conquer to solve a given problem
CO 5:	Apply the dynamic programming to estimate the computational complexity of different algorithms.

Reference Books:

1. **Introduction to Algorithms** by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 4th Edition, published by The MIT Press in April 2022.
2. **Introduction to the Design and Analysis of Algorithms** by Anany Levitin, 3rd Edition, published by Pearson Education in 2011.
3. **Data Structures & Algorithms Using C** by R.S. Salaria, 5th Edition, published by Khanna Publishing House in 2024.
4. **Computer Algorithms** by Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran, 2nd Edition, published by Silicon Press in 2007.

Web links and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf
3. https://mrcet.com/downloads/digital_notes/IT/Design%20and%20Analysis%20Algorithms.pdf

B.N.M. Institute of Technology

An Autonomous Institution under VTU
Department of Information Science & Engineering
Semester: V

Course Name: Cloud Computing
Course Code: 23ISE1564

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Insight into the basics of cloud computing along with Infrastructure.
2	To familiarize cloud computing and its Virtualization.
3	Categorizing cloud platforms used for Application Development.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Overview of cloud computing: Network-Centric Computing and Network-Centric Content, Peer-to-Peer Systems, Cloud Computing: An Old Idea Whose Time has Come, Cloud Computing Delivery Models and Services, Ethical Issues in Cloud Computing, Cloud Vulnerabilities, Major Challenges Faced by Cloud Computing,	**08**	**Understand**
Module-2:		
Cloud Infrastructure: Cloud Computing at Amazon, Cloud Computing: The Google Perspective, Microsoft Windows Azure and Online Services, Open-Source Software Platforms for Private Clouds, Cloud Storage Diversity and Vendor Lock-in, Cloud Computing Interoperability: The Intercloud, Energy Use and Ecological Impact of Large-Scale Data Centers, Energy Use and Ecological Impact of Large-Scale Data Centers, Service- and Compliance-Level Agreements, Responsibility Sharing Between User and Cloud Service Provider.	**08**	**Understand**
Module-3:		
Cloud Computing Applications and Paradigms: Challenges for Cloud Computing, Existing Cloud Applications and New Application Opportunities, Architectural Styles for Cloud Applications, Workflows: Coordination of Multiple Activities, Coordination Based on a State Machine Model: The ZooKeeper, The MapReduce Programming Model. A Case Study: The GrepTheWeb Application.	**08**	**Apply**
Module-4:		
Cloud Resource Virtualization: Virtualization, Layering and Virtualization, Virtual Machine Monitors, Virtual Machines, Performance and Security Isolation, Full Virtualization and Paravirtualization, Hardware Support for Virtualization. Case Study: Xen, a VMM Based on Paravirtualization.	**08**	**Apply**
Module-5:		
Cloud Application Development: Amazon Web Services: EC2 Instances, Connecting Clients to Cloud Instances Through Firewalls, Security Rules for Application and Transport Layer Protocols in EC2, How to Launch an EC2 Linux Instance and Connect to it, How to Use S3 in Java, How to Manage SQS Services in C#, How to Install the Simple Notification Service on Ubuntu 10.04, How to Create an EC2 Placement Group and Use MPI, How to Install Hadoop on Eclipse on a Windows System.	**08**	**Analyze**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Ability to apply knowledge of fundamentals of Cloud Computing.
CO 2:	Outline the Infrastructure of cloud.
CO 3:	Analyse the cloud Application and Paradigms.
CO 4:	Ability to analyze Cloud Resource Virtualization.
CO 5:	Analyze the platforms for development of cloud applications.

Reference Books:

1. **Cloud Computing: Theory and Practice** by Dan C. Marinescu, 3rd Edition, published by Morgan Kaufmann in 2022.
2. **Cloud Computing** by Shailendra Singh, published by Oxford University Press in 2018.
3. **Mastering Cloud Computing: Foundations and Applications Programming** by Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, 2nd Edition, published by McGraw Hill in 2024

Web links and Video Lectures:

1. http://nptel.ac.in/courses/106106129/21
2. https://freevideolectures.com/course/3649/cloud-computing
3. https://www.youtube.com/watch?v=Eg4AAGCE7X4&list=PL2UlrhJ_JwyA5IlOCdEWlNArFke4jgtlg

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: Cryptography and Information Security

Course Code: 23ISE161

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	To understand Cryptography Theories, Algorithms and Systems.
2	To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.
3	To study Information Security Models, threats, and attacks.
4	To know the legal, ethical and professional issues in Information Security
5	To know the technological aspects of Information Security

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad, Transposition Techniques. Steganography- Foundations of modern cryptography: Perfect security – Information theory – Product cryptosystem – Cryptanalysis.	8	Understand
Module-2:		
Mathematics of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclid‟s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- Traditional Block Cipher Structure – Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher Structure, The Feistel Cipher, Block Cipher Design Principles Symmetric key Cipher: introduction to SDES, Advanced Encryption Standard - Stream Ciphers, RC4.	8	Understand

Module-3:	No. of hours	Blooms cognitiveLevels
Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem – Exponentiation and logarithm – Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange, Introduction to ElGamal cryptosystem and Elliptic curve cryptography. Cryptographic Hash Functions: Secure Hash Algorithm (SHA) – SHA-512 Logic, SHA-512 Round Function. Digital Signature Standard (DSS).	8	Understand
Module-4:		
Introduction to Information Security: Introduction, The history of Information Security, what is security? Critical characteristics of Information, CNSS security model, Components of an Information System - The security systems development life cycle. The need for security: Threats and Attacks, Professional, Legal, Ethical Issues in information Security.	8	Understand
Module-5:		
Security Analysis: Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk. **Security Technologies:** Introduction, Access Control, Firewalls, Protecting Remote Connections, Intrusion Detection and Prevention Systems – Honeypots, Honeynets and Padded Cell Systems – Scanning and Analysis Tools – Bio metric Access Controls.	8	Understand

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

CO 1: Understand the basic concepts of classical encryption techniques, block ciphers, stream ciphers, cryptographic functions, key management, and IP security.

CO 2: Explain the structure of various block ciphers and stream ciphers.

CO 3: Apply public key cryptosystems, hash functions and key distribution techniques in real time applications.

CO 4: Understanding the critical characteristics, approaches and need for Information Security.

CO 5: Infer the aspects of risk management and security technologies.

Reference Books:

1. Cryptography and Network Security – Principles and Practice by William Stallings, Person, 8th Edition, 2022.
2. Principles of Information Security, 6th edition, Michael E Whittman, Herbert J Mattord, CENGAGE Learning, 2021.
3. Network Security Essentials Applications and Standards, William Stallings, Pearson, 6th Edition, 2016.
4. Network Security Private Communication in a Public world, Charlie Kaufman, Radia Perlman and Mike Speciner, 3rd Edition, PHI, 2019.
5. Network Security and Management, Brijendra Singh, 3rd Edition, PHI, 2013.

Web links and Video Lectures:

1. https://dl.hiva-network.com/Library/security/Cryptography-and-network-securityprinciples-and-practice.pdf.
2. https://imcs.dvfu.ru/lib.int/docs/Networks/Security/Network%20Security%20Foundati

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: Cloud Computing And Its Applications

Course Code: 23ISE162

L:T:P:J	**2:0:1:2**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**100**
Hours:	**40**	**SEA Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the concepts of cloud computing, virtualization and classify services of cloud computing
2	Illustrate architecture and programming in cloud.
3	Define the platforms for development of cloud applications and List the application of cloud.

Module-1: INTRODUCTION	**No. of hours**	**Blooms cognitive Levels**
Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.	8	Apply
Module-2: CLOUD-ENABLING TECHNOLOGIES		
Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish? Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices – Virtualization Support and Disaster Recovery. **List of programs:** • Install Virtual box/VMware Workstation with different flavors of Linux or Windows OS on top of windows7 or 8. • Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs.	8	Apply
Module-3: CLOUD ARCHITECTURE, SERVICES AND STORAGE		
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3. **List of programs:** • Install Google App Engine. Create hello world app and other simple web applications using python/java. • Use GAE launcher to launch the web applications.	8	Apply

Module-4: RESOURCE MANAGEMENT AND SECURITY IN CLOUD	No. of hours	Blooms cognitive Levels
Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security	8	Apply
Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards. **List of programs:** • Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. • Find a procedure to transfer the files from one virtual machine to another virtual machine.		
Module-5: CLOUD TECHNOLOGIES AND ADVANCEMENTS		
CLOUD APPLICATION PROGRAMMING AND THE ANEKA PLATFORM: Framework overview, Anatomy of the Aneka container, Building Aneka clouds, Cloud programming and management INDUSTRIAL PLATFORMS AND NEW DEVELOPMENTS: Amazon web services. Google AppEngine, Microsoft Azure. **Lab Component:** 7. Design and deploy a web application in a paas 8. Working with Mangra soft Aneka Software	8	Apply

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the concepts of cloud computing, virtualization
CO 2:	Identify different cloud delivery models and services.
CO 3:	Illustrate architecture and programming in cloud.
CO 4:	Illustrate the security in cloud and virtual machine.
CO 5:	Analyze the advantages in cloud technology.

Reference Books:

1. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, 2nd Edition, Morgan Kaufmann, 2018.
2. John W. Rittinghouse, James F. Ransome, Cloud Computing: Implementation, Management, and Security, 3rd Edition, CRC Press, 2016.
3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, 1st Edition, Tata McGraw Hill Education, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, 1st Edition, Tata McGraw Hill Education, 2010.
5. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, 1st Edition, O'Reilly Media, 2009.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/106/105/106105167/
2. https://www.youtube.com/watch?v=EN4fEbcFZ_E
3. https://www.guru99.com/cloud-computing-for-beginners.html
4. https://www.simplilearn.com/tutorials/cloud-computing-tutorial

https://www.mygreatlearning.com/cloud-computing/tutorials

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Department of Information Science and Engineering

Artificial Intelligence And Machine Learning

SEMESTER – VI

Course Code: 23ISE163	**L: T:P:J 2:2:2:0**	**CIA: 50**
Credits:	**04**	**SEA: 50**
Hours:	**50**	**SEE Duration:03**

Course Learning Objectives: This course will enable students to:

1. Explain the basics of Artificial Intelligence and Machine Learning algorithms
2. Identify the problems where Artificial Intelligence and Machine Learning techniques are applicable.
3. Discuss knowledge representation issues and different kinds of learning algorithms.
4. Compare learning strategy adopted by various kinds of machine learning algorithms.

Module – 1	**Teaching Hours**	**Blooms cognitive Levels**
What is artificial intelligence (AI)? The foundations of AI, The history of AI, The state of the Art, Intelligent Agents: Agents and Environments, Good Behavior: The concept of Rationality, The nature of the environment, The structure of Agents. Programs:1	10	Apply
Module – 2		
Solving Problems by Searching: Problem Solving Agents, Example problems, searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic functions, Constraint satisfaction problems: Defining constraint satisfaction problems, Constraint propagation: Inference in CSPs, Local search for CSPs, The structure of problems. Programs:2,3,4	10	Apply
Module-3		
Introduction: What is machine learning, Types of Machine learning systems, Well Posed Learning problem, Designing Learning systems, Perspectives and Issues in machine learning, Concept Learning: Concept learning task, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm.	10	Apply

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm. Programs:5,6		
Module-4		
Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and least squared error hypotheses, Minimum Description Length Principle, Bayes Optimal Classifier, and Naive Bayes Classifier, Bayesian Belief network, EM Algorithm- General Statements of EM Algorithm. Programs:7,8,9	10	Apply
Module-5		
Neural Networks: Introduction, Neural Network Representations, Appropriate problems for Neural Networks, Perceptron's, Multilayer Networks and Back Propagation Algorithms. Reinforcement Learning: Introduction, The learning task, Q-Learning, Nondeterministic rewards and actions, and Temporal difference learning. Programs:10,11	10	Apply

List of Programs

1) Implement a program to demonstrate simple reflex agents.
2) Implement Best first search.
3) Implement A* Algorithm.
4) Implement Constraint satisfaction problem (CSP)
5) For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
6) Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
7) Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
8) Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
9) Implement EM Algorithm.
10) Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
11) Implement Q-learning algorithm.

Course outcomes: The students will be able to:

CO1	Develop Artificial Intelligent agents for simple applications

CO2	Apply searching algorithms to develop Artificial Intelligent agents.
CO3	Apply concept learning tasks to solve applications of ML
CO4	Apply Bayesian learning for classification problems.
CO5	Apply neural networks and reinforcement learning concepts to demonstrate applications in ML

Reference Books:

1. **Artificial Intelligence: A Modern Approach**, Stuart Russell, Peter Norvig, 4th Edition, Pearson Education, 2020, ISBN-13: 978-0134610993.
2. **Machine Learning**, Tom M. Mitchell, 1st Edition, McGraw Hill Education, 2017, ISBN-13: 978-12590969521.
3. Artificial Intelligence: A Modern Approach Stuart Russel Peter Norvig Pearson Education 4th edition 2020.
4. Machine Learning Tom M Mitchell McGraw Hill Education, 1st Edition, 2017.
5. Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems Aurelien Geron Shroff/O'Reilly Media 3rd Edition, 2022.
6. Introduction to Machine Learning Ethem Alpaydin PHI Learning Pvt. Ltd 4th Edition, 2020.
7. 5. Structures and Strategies for Complex Problem-Solving George FLuger Pearson Education 5th Edition, 2011.

WEB links and Video Lectures

1. https://cloud.google.com/learn/artificial-intelligence-vs-machine-learning
2. https://onlinecourses.nptel.ac.in/noc19_me71/preview
3. https://youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&feature=shared

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Department of Information Science and Engineering

SEMESTER - VI

Virtual Reality and Augmented Reality
Scheme 2023

Course Code	23ISE164	CIA Marks	50
Teaching Hours/Week (L:T:P:J)	0:0:2:2	SEA Marks	50
Total Number of Hours	30	Exam Hours	03

Course Learning Objectives:

- Experience the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR
- Demonstrate the Geometric Modelling Techniques Review the Virtual Environment
- Develop VR/AR Technologies Simulate and Apply Virtual/Augmented Reality to varieties of Applications.

	Number of Hours	**Bloom's Level**
Module 1		
Blender Introduction • Demonstrate Blender Interface, Overlay Reference, Position on Overlay, Managing Layouts, Camera Overlay • Demonstrate Scene view navigation, Scene view camera, Game View. • Project Creation, Plane creation, cube creation, Explanation of cube camera and position, Material Selection, and class file same, adding motion to the script, Run. • Understanding different 3D projectiles	**4+ 2(Project)**	**Apply**
Module 2		
Blender Programming • Show the use of blender for Creating, loading and saving the scenes. • Demonstrate the Transforms, Components, 3D objects, creating components, Saving the work. • Demonstrate the Layers, Constraints, Editor Feature 3d mode, Preferences, Build settings, Sculpting, preference add Ons	**4+ 2(Project)**	**Apply**

• Installation of XR device, Viewing through the XR.		
Module 3		
Graphics • Demonstrate the use of Render Pipelines, Cameras, lighting, models, mirroring objects • Demonstrate the use of Meshes, Textures, shaders, materials • Demonstrate the concept Visual effects, sky, colour for suitable example. • Demonstrate the concept of World Building, Terrain, tree Editor for suitable example. • Demonstrate XR Plug-in Management, Installation of packages. • Demonstrate Creation of left-hand, left-hand Controller and right-hand controller.	**4+ 2(Project)**	**Apply**
Module 4		
Scripting, Audio Video and Animation • Demonstrate the Setting up scripting Environment. • Apply the concepts for Creating frames, creating .mkv files, namespaces, attributes • audio files, tracker Modules, Audio Group inspector. • Demonstrate for suitable example to create Animation, Rotation in animation, animation clips, Humanoid avatars, Animation.	**4+ 2(Project)**	**Apply**
Module 5		
Augmented reality • Program to show augmented reality. • Program to show The Relationship Between Augmented Reality and Other Technologies-Media, Technologies. • Program to show Spectrum Between Real and Virtual Worlds, applications of augmented reality Augmented.	**4+ 2(Project)**	**Apply**
Mini project • Using VR exploring the human body level by level, including cell level. • Using VR describing how medicine and body cures the illness. • Touchless ATM Using Augmented Reality. • Augmented Reality Controlled Hologram. • Augmented Reality House devices. • Augmented Reality Agriculture Field. • Augmented Reality and Medical devices. • VR Game Development. • VR Application Development. • Development of AI controlled VR Device, that accurately work to keep the clarity very good and using technology keep the eye healthy. • Development of Cardboard VR device as activity. • Improvising the quality of the VR Device and determining the accuracy.		

- Development of Satellite with the capability of VR Camera and more features.
- Ability to view the Solar system using the VR Device using compatible camera sent through the satellite.

Course Outcomes:

The students will be able to

- Apply navigation and utilize the Blender interface effectively, create and manipulate basic 3D objects, and apply materials and textures to develop complex scenes.
- Create, load, and save scenes using Blender's scripting capabilities, apply transformations and constraints, and integrate components such as XR devices for enhanced virtual reality experiences.
- Apply the concepts of render pipelines, shaders, and visual effects to create realistic and immersive graphics, and manage environments with world-building tools, including terrain and lighting.
- Develop skills in setting up scripting environments, creating and manipulating animations, and integrating audio and video files to enhance 3D scenes, including the creation of humanoid avatars and animation clips.
- Design and implement augmented reality applications, understanding the relationship between AR and other media technologies, and apply these concepts to real-world scenarios bridging the gap between real and virtual environments.

References:

1. Gregory C. Burdea & Philippe Coiffet, Virtual Reality Technology, 3rd Edition, Wiley-IEEE Press, 2024, ISBN 978-1394306947
2. Allan Fowler, AR Game Development, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178
3. Allan Fowler, Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178
4. Donald D. Hearn, M. Pauline Baker & Warren Carithers, Computer Graphics with OpenGL, 4th Edition, Pearson Education, 2011, ISBN 978-0136053583
5. Unity Manual – Scripting Documentation (2023.2)
6. Steven M. LaValle, Virtual Reality, Cambridge University Press, 2023, ISBN 978-1107198937
7. William R. Sherman & Alan B. Craig, Understanding Virtual Reality: Interface, Application, and Design, 2nd Edition, Morgan Kaufmann Publishers, 2018, ISBN 978-0128010389

Professional Elective – 1

B.N.M. Institute of Technology

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Department of Information Science & Engineering

Semester: VI

Course: Data Mining

Course Code: 23ISE1651

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the principles of Data warehousing and Data Mining
2	Be familiar with the Data warehouse architecture and its Implementation
3	Classify and predict the given data for the application development

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Data modelling: Basic Concepts- A multitier Architecture, Data warehouse models**:** Enterprise warehouse- Data mart and virtual warehouse, Extraction, Transformation and loading- Data Cube: A multidimensional data model- Stars, Snowflakes and Fact constellations: Schemas for multi dimensional Data models- Dimensions: The role of concept Hierarchies- Measures: Their Categorization and computation, Typical OLAP Operations.	**8**	**Understand**
Module-2:		
Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture of A Typical Data Mining Systems- Classification of Data Mining Systems. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining	**8**	**Understand**
Module-3:		
Association Analysis :- Association Analysis: Problem Definition- Frequent Item set Generation- Rule generation- Alternative Methods for Generating Frequent Item sets- FP-Growth Algorithm- Evaluation of Association Patterns	**8**	**Apply**

Module-4:		
Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis	**8**	**Analyze**

Case Study: Customer Segmentation of E-Commerce data using Clustering Algorithms		
Module-5:		
Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web **Case Study:** Interpreting Twitter Data from ongoing technical developments in country Tweets	**8**	**Analyze**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the principles of Data Modeling
CO 2:	Understand the principles of Data Mining
CO 3:	Apply the concepts of association analysis
CO 4:	Analyze the concepts of various clusters
CO 5:	Analyze the concepts of spatial and multimedia mining

Reference Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson Education, 2018.
2. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, 3rd Edition, Elsevier, 2011.
3. Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining & OLAP, 3rd Edition, McGraw Hill Education, 2015.
4. K.P. Soman, Shyam Diwakar, V. Ajay, Insight into Data Mining Theory and Practice, 2nd Edition, Prentice Hall of India, 2019.
5. G. K. Gupta, Introduction to Data Mining with Case Studies, 2nd Edition, PHI Learning, 2017.
6. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson Education, 2018.

Web links and Video Lectures:

1. https://www.udemy.com/topic/data-warehouse/
2. https://www.coursera.org/professional-certificates/microsoft-azure-dp-203-data-engineering
3. https://www.edx.org/learn/data-warehouse
4. https://alison.com/tag/data-mining

https://www.datacamp.com/courses/introduction-to-data-warehousing

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: Block Chain Technologies: Platforms and Applications

Course Code: 23ISE1652

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**36**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the basic concepts of blockchain technology.
2	Applications of Blockchain and its technologies for bitcoin and cryptocurrencies.
3	Demonstrate the functioning of smart contracts with the help of Ethereum 101.
4	Apply the concept of hyperledger for creation of distributed and personalized blockchains.
5	Build and Implement blockchain technology for real world applications.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Blockchain: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain. **Decentralization and Cryptography:** Decentralization using blockchain, Cryptography and Technical and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys	**L :08**	**Understand**
Module-2:		
Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payment B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash.	**L : 07**	**Apply**
Module-3:		
Smart Contracts and Ethereum 101: Smart Contracts: Definition: Ricardi contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum of the Ethereum blockchain, Precompiled contracts.	**L : 07**	**Apply**
Module-4:		
Introduction to Hyperledger: What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.	**L : 07**	**Apply**
Module-5:		
Applications of Blockchains: Alternative block chain**:** Blockchain-Outside-of Currencies, Internet of Things, Government, Finance, Media,Medical Record Management System, Domain Name Service and Future of Blockchain.	**L : 07**	**Apply**

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

CO1	Understand the fundamental concepts of block chain technology
CO2	Apply the concepts of blockchain for bitcoin and crytocurrencies.
CO3	Apply the working of Smart Contracts through Etherereum 101
CO4	Apply the Concepts of Hyperledger for development of personalized and distributed blockchains
CO5	Create and Develop real world block chain based solutions using varieties of Block chain technology.

Reference Books:

1. Imran Bashir, Mastering Blockchain: Distributed Ledgers, Decentralization and Smart Contracts Explained, 2nd Edition, Packt Publishing Ltd, 2018, ISBN 978-1-78712-544-5.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, 1st Edition, Princeton University Press, 2016.
3. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, 1st Edition, Apress, 2017.
4. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 2nd Edition, O'Reilly Media, 2017.
5. Nitin Gaur, Anthony O'Dowd, Petr Novotny, Luc Desrosiers, Venkatraman Ramakrishna, Salman A. Baset, Blockchain with Hyperledger Fabric, 2nd Edition, Packt Publishing, 2020, ISBN 978-1839218750.

Web links and Video Lectures:

1. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/

2. Udemy: https://www.udemy.com/course/build-your-blockchain-az/

https://eduxlabs.com/courses/blockchain-technology- training/?tab=tab-curriculum

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

SEMESTER – VI

Course: Cyber Security

Course Code: 23ISE1653

L:T:P:J	**3:0:0:0**	**CIA**	**50**
Credits:	**03**	**SEA**	**50**
Hours:	**40**	**SEA Duration:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Explain the importance of cyber security
2	Explain the security issues in programming, web and OS.
3	Understand the various threats to network communications, and attacks such as denial of service (DoS) and distributed denial of serives.(DDoS)
4	Explore various aspects of Digital Forensics technology
5	By implementing, learners will have idea about computer crime.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: What Is Computer Security? Threats, Harm, Vulnerabilities, Controls, Conclusion, What's Next? **Toolbox:** Authentication, Access Control, and Cryptography: Authentication, Access Control.	**8**	**Understand**
Module-2:		
The Web—User Side: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. **Operating Systems:** Security in Operating Systems, Security in the Design of Operating Systems, Rootkit.	**8**	**Apply**
Module-3:		
Networks: Network concepts, War on Networks: Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service.	**8**	**Apply**
Module-4:		
Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.	**8**	**Understand**

Module-5:		
Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies, Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand fundamental aspects of cyber security
CO 2:	Identify the security issues in web, network, Operating system
CO 3:	Identify common network security threats and methods used to mitigate these ricks
CO 4:	Illustrate computer forensic techniques to identify the digital forensics associated with criminal activities.
CO 5:	Apply forensic analysis tools to recover important evidence for identifying computer crime.

Reference Books:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 6th Edition, Pearson Education, 2022.
2. NIIT, Understanding Forensics in IT, Latest Edition, NIIT Publishing, 2020 (Note: Exact edition/year may vary, newer editions not widely available).
3. Nelson Phillips, Enfinger Steuart, Computer Forensics and Investigations, 5th Edition, Cengage Learning, 2023.
4. John Sammons, Michael Cross, The Basics of Cyber Safety: Computer and Mobile Device Safety Made Easy, 2nd Edition, Elsevier, 2021.
5. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Cybersecurity Essentials, 3rd Edition, Wiley, 2023.
6. Imran Bashir, Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, 2nd Edition, Packt Publishing, 2018.
7. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, 1st Edition, Princeton University Press, 2016.

Web links and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://www.slideshare.net/Siblu28/cyber-security-36922359
3. https://www.geeksforgeeks.org/cyber-security-types-and-importance/
4. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#

Udemy: https://www.udemy.com/course/build-your-blockchain-az/

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: Data Visualization

Course Code: 23ISE1654

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Understand and describe the main concepts of data visualization, chart types and their recommended usage.
2	Create data visualizations and dashboards using Tableau Desktop
3	Identify the latest dashboard and reporting features of Microsoft Power BI
4	Make Use of data from multiple sources, create stunning visualizations
5	Identify the capabilities of Power BI mobile applications

Descriptions (if any):

Prerequisite

- Working knowledge of Programming Language.
- Windows or Apple O.S.
- CPUs must support SSE4.2 and POPCNT instruction sets
- Citrix environments, Microsoft Hyper-V, Parallels, and VMware.

Module-1:	**No. of hours**	**Blooms Cognitive Levels**
Introduction: Introduction to data visualization, Getting started with Tableau Desktop, Connecting to the tutorial dataset, Creating the charts. **Common charts**: Creating common visualizations (bar charts, line charts etc.), Filtering and sorting data, Adding Titles, Labels, and descriptions, Publish your work to Tableau Cloud.	**8**	**Understand**
Module-2:		
Interactions: Interactivity with text and visual tooltips, Interactivity with actions (filter, highlight, URL), Assembling dashboards from multiple charts. **Transform the data:** Creating simple calculations in Tableau**,** Using table calculations**,** Introduction to Tableau Preparation.	**8**	**Apply**
Module-3:	**No. of hours**	**Blooms Cognitive Levels**
Preparing Data Sources: Query folding, Query design per dataset mode, Import mode dataset queries, Direct Query dataset queries, Direct Query report execution, Composite datasets, and Table storage modes. **Data Sources:** Authentication, Data Source settings, Privacy levels, Power BIas a data source, Power BI Desktop options, Global options, Current FILE options.	**8**	**Apply**
Module-4:		

SQL views: SQL views versus M queries, SQL view examples, Date dimension view, Mark as date table, Product dimension view, Slowly changing dimensions. **Designing Dashboards:** Dashboard design, Visual selection, Layout, Navigation pane, Full screen mode, supporting tiles	**8**	**Apply**
Module-5:		
Dashboard Architecture Single dashboard Architecture, Multiple dashboard Architecture, Organizational Dashboard Architecture, Multiple datasets. **Dashboard Tiles:** Tile details and custom links, Real time data tiles, Dashboard themes**,** Mobile optimized dashboards	**8**	**Apply**

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

CO1: Understand and describe the main concepts of data visualization, chart types and their recommended usage.

CO2:Create data visualizations and dashboards using Tableau Desktop

CO3:Identify the latest dashboard and reporting features of Microsoft Power BI

CO4:Make use of data from multiple sources, create stunning visualizations

CO5:Identify the capabilities of Power BI mobile applications

Reference Books:

1. Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios, 1st Edition, Wiley, 2017.
2. Greg Deckler, Brett Powell, Leon Gordon, Mastering Microsoft Power BI: Expert Techniques to Create Interactive Insights for Effective Data Analytics and Business Intelligence, 2nd Edition, Packt Publishing, 2022.
3. Ryan Sleeper, Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, 1st Edition, O'Reilly Media, 2018.
4. Ben Fry, Visualizing Data: Exploring and Explaining Data with the Processing Environment, 1st Edition, O'Reilly Media, 2008.
5. Julie Steele, Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, 1st Edition, O'Reilly Media, 2011.

Web links:

- https://powerbi.microsoft.com
- https://www.tableau.com
- https://www.udemy.com/course/data-visualization-dashboard-design
- https://www.insightplatforms.com/10-free-tools-dashboards-data-visualization-infographics

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: UI Frameworks

Course Code: 23ISE1655

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	To understand the Front-end Web UI Framework.
2	To understand the essence of Bootstrap grid system and responsive design.
3	To understand the various Bootstrap CSS components
4	To understand the various Bootstrap Java script components
5	To understand the concept of Bootstrap and JQuery Web Tools

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Front-end Web UI Frameworks Overview: Front-End Web UI Frameworks and Tools: Bootstrap 4, How to Use the Learning Resources, What is Full-Stack Web Development? Setting up Git, Basic Git Commands, Online Git Repositories, Front-end Web UI Frameworks.	**8**	**Understand**
Module-2:		
Introduction to Bootstrap: Getting Started with Bootstrap, Responsive Design, Bootstrap Grid System, Responsive Design and Bootstrap Grid System.	**8**	**Understand**
Module-3:		
Bootstrap CSS Components: Navigation and Navigation Bar, Navbar and Breadcrumbs, Icon Fonts, Icon Fonts, User Input, Buttons, Forms, Bootstrap Tables and Cards, Displaying Content: Tables and Cards, Images and Media, Alerting Users.	**8**	**Apply**
Module-4:		
Bootstrap Javascript Components: Bootstrap JavaScript Components, Tabs, Pills and Tabbed Navigation, Tabs, Collapse and Accordion, Accordion, Tooltips, Popovers and Modals, Tooltips and Modals, Carousel.	**8**	**Apply**
Module-5:		
Web Tools: Bootstrap and JQuery, More Bootstrap and JQuery, CSS Preprocessors: Less and Sass, Less, Scss, Building and Deployment, Task Runners, Grunt, Web UI Frameworks.	**8**	**Apply**

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

CO 1:Understand the Front-end Web UI Framework and basic Git commands

CO 2:Understand the Bootstrap grid system and responsive design

CO 3:Develop an application using bootstrap CSS components

CO4:Develop an application using bootstrap Javascript Components

CO5:Building and Deployment of applications

Reference Books:

1. Chong Lip Phang, Mastering Front-End Web Development: 14 Books in 1. Introducing 200+ Extensions. An Advanced Guide, 1st Edition, Independently Published, 2020.
2. Benjamin Jakobus, Jason Marah, Mastering Bootstrap 4, 2nd Edition, Packt Publishing, 2018.
3. Matt Lambert, Learning Bootstrap 4, 2nd Edition, Packt Publishing, 2016.
4. Riwanto Megosinarso, Step By Step Bootstrap 3: A Quick Guide to Responsive Web Development Using Bootstrap 3, 1st Edition, CreateSpace Independent Publishing, 2014.
5. Jennifer Kyrnin, Bootstrap in 24 Hours, Sams Teach Yourself, 1st Edition, Pearson Education, 2015.

Web links and Video Lectures:

1. https://coursesity.com/course-detail/front-end-web-ui-frameworks-and-tools-bootstrap-4
2. https://medium.com/swlh/front-end-web-ui-frameworks-and-tools-bootstrap-4-fb3906d885ff
3. https://getbootstrap.com/docs/5.3/getting-started/introduction/
4. https://www.youtube.com/watch?v=-qfEOE4vtxE
5. https://www.youtube.com/watch?v=e

B.N.M. Institute of Technology

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Department of Information Science & Engineering

Semester: VI

Course: Strategic Management

Course Code: 23ISE1656

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits: 03	**03**	**SEA**	**: 50**
Hours: 36	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	To provide a framework for students to understand strategic management concepts and conduct external analysis for competitive advantage.
2	To help students develop a thorough understanding of principles and models related to an organization's internal analysis.
3	To help students understand the different strategy options available for organizations in a complex and dynamic environment.

Module-1: Introduction to Strategic Management and External Analysis	**No. of hours**	**Blooms cognitive Levels**
Meaning and Characteristics of Strategic Management; The Strategic Management Process. **External Analysis**– PESTLE analysis, Environment Threat and Opportunity Profile (ETOP); Industry Analysis –Porter's Dominant Economic Features, Porter's Five Forces Model, Strategic Group Mapping; Industry Key Success Factors, Key Performance Indicators and Key Result Areas.	**8**	**Apply**
Module-2: Internal Analysis		
Strategic Vision, Mission, Goals, Long-Term and Short-Term Objectives and their Value to the Strategic Management Process; Organizational Capability Profile – Resource Based View of the firm (RBV) and VRIN; Business Portfolio Analysis – BCG / Growth Share Matrix, GE 9 Cell Model; Balanced Score Card, SWOC Analysis, Value Chain Analysis, Benchmarking.	**8**	**Apply**
Module-3: Strategy Formulation		
Corporate Strategies: Growth Strategies – Internal Growth, External Growth (Integration, Diversification, Mergers, Joint Ventures, Strategic Alliances), Product/Market Expansion grid / Ansoff's Matrix; Stability Strategies – NoChange, Profit and Proceed with Caution.	**8**	**Apply**
Module-4:Strategy Implementation		
Facilitators for implementation of strategy: Organisational Structures – matching structure to strategy, McKinsey's 7S, Changing structure and processes (Business Process Reengineering, Six Sigma); Strategic Leadership; Organisational Culture – Learning organisations, MBO, TQM.	**8**	**Apply**

Module-5: Strategic Control		
Focus of Strategic Control, Establishing Strategic Controls (Premise Control, Strategic Surveillance, Special Alert Control, Implementation Control), Exerting Strategic Control (through Competitive Benchmarking, Performance and Formal and Informal Organisations).	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand strategic management concepts and how to conduct external analysis for competitive advantage.
CO 2:	Apply selected models of internal analysis to evaluate an organization.
CO 3:	Understand and analyse the different strategy options available for organizations in a complex and dynamic environment.
CO 4:	Appreciate the essential factors in strategy implementation.
CO 5:	Understand how to establish and exert strategic control.

Reference Books:

1. Stewart Clegg, Chris Carter, Martin Kornberger, Jochen Schweitzer, Strategy: Theory and Practice, 3rd Edition, SAGE Publications, 2020.
2. John A. Parnell, Strategic Management: Theory and Practice, 7th Edition, Academic Media Solutions, 2025.
3. Arthur A. Thompson Jr., Margaret A. Peteraf, John E. Gamble, A. J. Strickland III, Arun K. Jain, Crafting and Executing Strategy: The Quest for Competitive Advantage – Concepts and Cases, 23rd Edition, McGraw Hill Education, 2024.

Web links and Video Lectures:

1.https://www.edx.org/learn/strategic-management
2.https://www.youtube.com/watch?v=ZmRK9wc3hjI
3. https://ipbusinessacademy.org/wp-content/uploads/2021/02/Lecture-NotesPart1.pdf

Professional Elective – 2 (MOOC Course)

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course Name: Natural Language Processing

Course Code: 23ISE1661

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	To learn the fundamentals of natural language processing
2	To understand the use of CFG and PCFG in NLP
3	To understand the role of semantics of sentences and pragmatics
4	To apply the NLP techniques to IR applications
5	Compare and contrast the use of different statistical approaches for different types of NLP applications

Module-1: Introduction	**No. of hours**	**Blooms cognitive Levels**
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance	**8**	**Understand**
Module-2: Word Level Analysis		
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.	**8**	**Apply**
Module-3: Syntactic Analysis		
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.	**8**	**Apply**
Module-4: Semantics and Pragmatics		
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.	**8**	**Apply**
Module-5: Discourse Analysis and Lexical Resources		

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	To tag a given text with basic Language features
CO 2:	To design an innovative application using NLP components
CO 3:	To implement a rule based system to tackle morphology/syntax of a language
CO 4:	To design a tag set to be used for statistical processing for real-time applications
CO 5:	To compare and contrast the use of different statistical approaches for different types of NLP applications.

Reference Books:

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 3rd Edition 2025.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O_Reilly Media, 2009.
3. Breck Baldwin, ―Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
4. Richard M Reese, ―Natural Language Processing with Java‖, O_Reilly Media,2nd Edition 2018.
5. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
6. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course Name: NoSQL

Course Code: 23ISE1662

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SE**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Compare different types of NoSQL Databases
2	Compare and contrast RDBMS with different NoSQL databases.
3	Demonstrate the detailed architecture Document-oriented NoSQL databases.
4	Explain performance tune of Key-Value Pair NoSQL databases.
5	Apply Nosql development tools on different types of NoSQL Databases.

Module-1: Why NoSQL	**No. of hours**	**Blooms cognitive Levels**
Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points	**8**	**Understand**
Module-2: Aggregate and Distributed Data model		
Aggregate, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. Replication and sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.	**8**	**Apply**
Module-3: Document Databases		
Document oriented 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, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	**8**	**Apply**
Module-4: Column-Family Store and Key-Value Databases		
Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage. Key-Value Database: Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases.	**8**	**Apply**

Module-5: Graph Databases	**No. of hours**	**Blooms cognitive Levels**
Graph Databases, Graph Database. Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases. Graph NoSQL databases using Neo4, NoSQL database development tools and programming languages. NoSQL Key/Value databases using MongoDB.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand different types of NoSQL Databases.
CO 2:	Compare Relational Database to NoSql stores and explain Sharding and Replication
CO 3:	Illustrate the Document-oriented NoSQL databases
CO 4:	Understand column oriented NoSql Database.
CO 5:	Understand detailed architecture of Graph NoSQL databases and apply Nosql Development tools with suitable usecase.

Reference Books:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019.

Web Reference:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/.
4. https://www.javatpoint.com/nosql-database

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Department of Information Science & Engineering

SEMESTER – VI

Course Name: Operation Research

Course Code: 23ISE1663

L:T:P:J	**3:0:0:0**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**50**
Hours:	**40**	**SEA Duration**	**:**	**03Hours**

Course Learning Objectives: The students will be able to

1	To understand the methodology of OR problem solving and formulate linear programming problem.
2	Describe numerous problem-solving approaches for optimization.
3	Solve linear programming problems using simplex method, Big M method 2- phase method.
4	Identify the problems of transportation and assignment problem, and then solve it.
5	Use game theory as a case study in a decision support system.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction, Linear Programming: Introduction: The origin, nature and impact of OR; Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation . Introduction to Linear Programming Problem (LPP): Prototype Example Assumption of LPP, Formulation of LPP and Graphical Method Various Examples.	**8**	**Understand**
Module-2:		
Simplex Method–1: The essence of the simplex method; Setting up the simplex method; Types of variables, Algebra of the simplex method; the simplex method in tabular form; Tiebreaking in the simplex method, BigM method, Two phase method.	**8**	**Apply**
Module-3:		
Simplex Method–2: Duality Theory-The essence of duality theory, Primal dual relationship, conversion of primal to dual problem and viceversa. The dual simplex method.	**8**	**Apply**
Module-4:		
Transportation and Assignment Problems: The transportation problem, Initial Basic Feasible Solution (IBFS) by North West Corner Rule method, Matrix Minima Method, Vogel's Approximation Method. Optimal solution by Modified Distribution Method (MODI).The Assignment problem; A Hungarian algorithm for the assignment problem. Minimization and Maximization varieties in Transportation and assignment problems.	**8**	**Apply**

Module-5:	No. of hours	Blooms cognitive Levels
Game Theory: Game Theory: The formulation of two persons, zero sum games; saddle point, maximin and minimax principle, Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
CO 2:	Determine optimal strategy for products using various methods
CO 3:	Solve linear programming problems using duality theory and post optimality analysis
CO 4:	Understand the given problem as transportation and assignment problem and solve.
CO5:	Illustrate game theory for decision support system.

Reference Books:

1. D.S. Hira, P.K. Gupta, Operations Research, Revised Edition, S. Chand & Company Ltd, 2018.
2. S. Kalavathy, Operations Research, 4th Edition, Vikas Publishing House Pvt Ltd, 2010.
3. S.D. Sharma, Operations Research, 13th Edition, Kedar Nath Ram Nath Publishers, 2019.
4. Kantiswaroop, P.K. Gupta, Man Mohan, Operations Research, 4th Revised Edition, Sultan Chand & Sons, 2016.
5. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operations Research, 10th Edition, McGraw-Hill Education, 2014.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/112/106/112106134/#
2. http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/techniq.htm
3. https://indiafreenotes.com/operations-research-techniques/
4. https://nptel.ac.in/courses/110106062
5. https://onlinecourses.nptel.ac.in/noc22_ma48/preview

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course Name: Deep Learning

Course Code: 23ISE1664

L:T:P:J	**3:0:0:0**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**50**
Hours:	**40**	**SEA Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Introduce students to deep learning algorithms and their applications in order to solve real problems.
2	Understand the concepts of deep learning, including neural networks, activation functions, and the learning process.
3	Gain experience in deploying deep learning models to solve practical problems.
4	Course Learning Outcomes

Module-1: Introduction	**No. of hours**	**Blooms cognitive Levels**
Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.	**8**	**Understand**
Module-2: Neural Networks		
Feedforward neural networks, deep networks, regularizing a deep network, model exploration, and hyper parameter tuning.	**8**	**Understand**
Module-3: Convolution Neural Networks		
Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.	**8**	**Apply**
Module-4: Sequence Modeling		
Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architecture deep recurrent networks, LSTM networks.	**8**	**Apply**
Module-5: Autoencoders		
Undercomplete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders..	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Describe the feed-forward and deep networks
CO 2:	Design single and multi-layer feed-forward deep networks and tune various hyper-parameters
CO 3:	Implement deep neural networks to solve a problem
CO 4:	Analyze performance of deep networks.

Reference Books:

1. Bunduma, N., Fundamentals of Deep Learning, 1st Edition, 2017.
2. Heaton, J., Deep Learning and Neural Networks, Heaton Research Inc., 2nd Edition, 2017.
3. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, MIT Press, 1st Edition, 2016.
4. Deng, L., Yu, D., Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing), Now Publishers, 1st Edition, 2014.
5. Hall, M.L., Deep Learning, VDM Verlag, 1st Edition, 2011.

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An Autonomous Institution under VTU

Department of Information Science and Engineering

SEMESTER – VI

Course: Agile Software Development

Course Code: 23ISE1665

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**36**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	To understand how an iterative, incremental development process leads to faster delivery of more useful software
2	To understand the essence of agile development methods
3	To understand the principles and practices of extreme programming
4	To understand the roles of prototyping in the software process
5	To understand the concept of Mastering Agility

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Agile: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, **How to Be Agile?:** Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor	**06**	**Understand**
Module-2:		
Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, **Adopting XP:** Is XP Right for Us?, Go!, Assess Your Agility.	**06**	**Understand**
Module-3:		
Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, **Collaborating:** Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand- Up Meetings, Coding Standards, Iteration Demo, Reporting, **Releasing:**"Done Done", No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation, **Planning:** Vision, Release Planning, The Planning Game, Iteration Planning, Slack, Stories, Estimating, **Developing:** Incremental Requirements, Customer Tests, Test-Driven Development, Refactoring, Simple Design, Incremental Design and Architecture, Spike Solutions.	**08**	**Analyze**

Module-4:		
Mastering Agility: Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, **Improve the Process:** Understand Your Project, Tune and Adapt, Break the Rules, **Rely on People:** Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, **Eliminate Waste:** Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput.	**08**	**Analyze**
Module-5:		
Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, **Seek Technical Excellence:** Software Doesn't Exist, Design Is for Understanding, Design Tradeoffs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery.	**08**	**Analyze**

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

CO 1: Understand the essence of agile development methods

CO 2: Understand The XP Lifecycle, XP Concepts, Adopting XP

CO 3: Analyze the Work on Pair Programming, Root-Cause Analysis, Retrospectives, Planning, Incremental Requirements, Customer Tests

CO 4: Analyze the concept of Mastering Agility

CO 5: Analyze the principles and practices of extreme programming

Reference Books:

1. **The Art of Agile Development** by James Shore and Shane Warden, 2nd Edition, published by O'Reilly Media in November 2021.
2. **Agile Software Development: Principles, Patterns, and Practices** by Robert C. Martin, 1st Edition, published by Prentice Hall in 2002.
3. **Agile and Iterative Development: A Manager's Guide** by Craig Larman, 1st Edition, published by Addison-Wesley in 2004.
4. **Essential Scrum: A Practical Guide to the Most Popular Agile Process** by Kenneth S. Rubin, 1st Edition, published by Addison-Wesley Professional in July 2012.
5. **Scrum: The Art of Doing Twice the Work in Half the Time** by Jeff Sutherland and J.J. Sutherland, 10th Anniversary Edition, published by Random House Business Books in 2024.

Web links and Video Lectures:

1. https://www.techtarget.com/searchsoftwarequality/definition/agile-software-development
2. https://www.atlassian.com/agile/kanban
3. https://www.atlassian.com/agile/scrum
4. https://www.simplilearn.com/tutorials/agile-scrum-tutorial/what-is-agile

https://www.youtube.com/watch?v=WjwEh15M5Rw

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Department of Information Science & Engineering

Semester: VI

Course Name: Knowledge Management

Course Code: 23ISE1666

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Hours:	**40**	**SEA Duration: 03Hours**

Course Learning Objectives: The students will be able to	
1	Understand the basics of knowledge creation and knowledge capture
2	Understand the mechanics of knowledge management
3	Understand the use of knowledge management strategy and application of KM tools

Module-1: Introduction	**No of hours**	**Blooms cognitive Levels**
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.	**8**	**Apply**
Module-2: Creating The Culture Of Learning And Knowledge Sharing		
Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.	**8**	**Apply**
Module-3: Knowledge Management-The Tools		
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Mana gement - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information	**8**	**Apply**
Module-4: Knowledge Management-Application		
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).	**8**	**Apply**

Module-5: Future Trends and Case Studies		
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategicand business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the basics of knowledge management
CO 2:	Understand and apply knowledge management models
CO 3:	Understand the mechanics of knowledge management
CO 4:	Understand and implement knowledge management strategy and knowledge management tools
CO 5:	Understand and apply ICT tools for effective knowledge management

Reference Books:

1. Srikantaiah, T.K., Koenig, M., *Knowledge Management for the Information Professional*, Information Today, Inc., **2nd Edition, 2014**
2. Nonaka, I., Takeuchi, H., *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, **Reprint Edition, 2021**
3. Frances Horibe, *Managing Knowledge Workers*, John Wiley & Sons, **Updated Edition, 2018**
4. Fernandez & Leidner, *Knowledge Management*, PHI Learning, New Delhi, **2nd Edition, 2017**
5. Ganesh Natarajan and Sandhya Shekhar, *Knowledge Management - Enabling Business Growth*, Tata McGraw Hill, **Revised Edition, 2016**
6. Elias M. Awad & Hassan M. Ghaziri, *Knowledge Management*, Pearson Education, **2nd Edition, 2004**

Web links and Video Lectures:

1.What is Knowledge Management? https://www.youtube.com/watch?v=3_eI5r55XhU 2.Knowledge Management and Innovationhttps://www.youtube.com/watch?v=DNUwZctwwhw

Open Elective

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Department of Information Science & Engineering

Semester: VI

Course Name: Introduction to Data Science

Course Code: 23ISE1671

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Hours:	**40**	**SEA Duration : 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand data collection and pre-processing techniques for data science
2	Identify fundamentals of R language and statistics
3	Utilize Iterative programming and functions in R for data handling.
4	Identify complex statistical operations using lists and data frames in R
3	Apply Data Reduction and Visualization Techniques

Module-1	**No. of hours**	**Blooms cognitive Levels**
Introduction to Data Science Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model.	**8**	**Understand**
Module-2		
Basics of R: Introduction, R Environment Setup, Programming with R, Basic Data Types. Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode.	**8**	**Apply**
Module-3		
Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data. Conditionals and Control Flow: Relational Operators, Logical Operators. Iterative Programming in R: Introduction, While Loop, For Loop.	**8**	**Apply**

Module-4		
Functions in R: Introduction, writing a Function in R, Nested Functions, Function Scoping, Loading an R Package, Mathematical Functions in R, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames. Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements.	**8**	**Apply**
Module-5		
Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand data collection and pre-processing techniques for data science.
CO2: Identify fundamentals of R language and statistics.
CO3: Utilize Iterative programming and functions in R for data handling.
CO4: Identify complex statistical operations using lists and data frames in R.
CO5: Apply Data Visualization Techniques.

Reference Books:

1. O'Neil, Cathy and Rachel Schutt, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly, **2013**
2. K G Srinivas, G M Siddesh, *Statistical Programming in R*, Oxford University Press, **Latest edition 2021**
3. Jiawei Han, Micheline Kamber, and Jian Pei, *Data Mining: Concepts and Techniques*, 3rd Edition, The Morgan Kaufmann Series in Data Management Systems, **3rd Edition, 2011**
4. Anand Rajaraman and Jeffrey D. Ullman, *Mining of Massive Datasets*, Cambridge University Press, **2nd Edition, 2014**
5. Joel Grus, *Data Science from Scratch*, Shroff Publishers / O'Reilly Media, **2nd Edition, 2019**
6. Andy Kirk, *Data-Driven Design: A Handbook for Data Visualization and Communication*, **Latest Edition, 2023**

Web links and Video Lectures:

1. https://www.javatpoint.com/r-tutorial
2. https://nptel.ac.in/courses/106106179
3. https://nptel.ac.in/courses/111104147
4. https://nptel.ac.in/courses/111104146
5. https://nptel.ac.in/courses/128106002

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Department of Information Science & Engineering

Semester: VI

Course Name: Software Testing

Course Code: 23ISE1672

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the importance of software testing fundamentals, methodologies, and tools.
2	Apply the knowledge of software testing strategies and methodologies for various types of testing
3	Identify the various types and testing strategies to find bugs in the software.
4	Investigate test planning and its management.
5	Demonstrate the usage of modern testing tools to write automation script

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Basics of Software Testing: Basic definitions, Software Quality, Requirements, Behavior and Correctness, Correctness versus Reliability, Testing and Debugging, Test cases, identifying test cases, Test-generation Strategies, Test Metrics, Error and fault taxonomies, Levels of testing, Testing and Verification, Static Testing, the triangle problem, commission problem, the SATM (Simple Automatic Teller Machine) problem.	**08**	**Understand**
Module-2:		
Functional Testing: Boundary value analysis, Robustness testing, Worst-case testing, Robust Worst testing for triangle problem, Nextdate problem and commission problem, Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, and the commission problem, Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem.	**08**	**Apply**
Module-3:		
Types and levels of Testing: Unit Testing: Driver, Stub **Integration Testing:** Top-Down integration, Bottom-up Integration, Bi-Directional Integration **Testing on Web application**: Performance Testing, Load testing, stress Testing, security Testing, Client-server Testing **Acceptance Testing:** Alpha Testing and Beta Testing, special Tests: Regression Testing, GUI Testing.	**08**	**Apply**

Module-4:		
Test Management: Test Planning: Preparing a test plan, Deciding Test approach, setting up criteria for testing, identifying responsibilities, Staffing, Resource Requirements, Test Deliverables, Testing Tasks. **Test Management:** Test infrastructure management, Test People Management **Test process:** Base Lining a test plan, Test case specification Test Reporting: Executing Test cases, Preparing Test summary Report.	**08**	**Apply**
Module-5:		
Testing Tools and Measurements: Manual Testing and need forautomation testing tools, advantages, and disadvantages of using tools,selecting a testing tool, when to use automated testing tools, testing using automated tools. Metrics and Measurement: Types of metrics, product metrics and process metrics, object-oriented metrics in testing.	**08**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the importance of software testing fundamentals, methodologies, and tools
CO2	Apply the knowledge of software testing strategies and methodologies for various types of testing.
CO3	Analyze various types of testing and identify bugs to create defect report of given application.
CO4	Explore test planning and its management.
CO5	Explore testing software for performance measures using automated testing tools.

Reference Books:

1. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing: Principles and Practices*, Pearson India, **2nd Edition, 2019**, ISBN: 9789352606510
2. Limaye M.G., *Software Testing: Principles, Techniques and Tools*, Tata McGraw Hill, **Latest Edition, 2018**
3. Paul C. Jorgensen, *Software Testing: A Craftsman's Approach*, 4th Edition, CRC Press (Auerbach Publications), **2013**
4. Naresh Chauhan, *Software Testing: Principles and Practices*, Oxford University Press, **2nd Edition, 2017**
5. Yogesh Singh, *Software Testing*, Cambridge University Press, Bengaluru, **1st Edition, 2019**, ISBN 978110765278X

Web links and Video Lectures:

1. http://www.selenium.com
2. https://nptel.ac.in/courses/106/105/106105150/
3. https://nptel.ac.in/courses/106/101/106101163/
4. www.toolsqa.com
5. http://en.wikipedia.org/wiki/Test_automation 6. 6.

http://en.wikipedia.org/wiki/Software_testing#Testing_tools

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Department of Information Science & Engineering

Semester: VI

Course Name: Introduction to Blockchain

Course Code: 23ISE1673

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the emerging abstract models for Blockchain Technology
2	Familiarize with the functional/operational aspects of crypto currency eco-system
3	Understand the security issues in block chain

Module-1: INTRODUCTION TO BLOCKCHAIN	**No. of hours**	**Blooms cognitive Levels**
Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.	**08**	**Understand**
Module-2: BLOCKCHAIN ARCHITECTURE		
Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)	**08**	**Understand**
Module-3: Ethereum basics: BLOCKCHAINS IN BUSINESS		
Public versus private and permissioned versus permission less blockchains Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain- as-a-Service- Initial Coin Offering (ICO) Ethereum and Smart Contracts	**08**	**Understand**
Module-4: PRIVACY, SECURITY ISSUES IN BLOCKCHAIN		
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks	**08**	**Understand**
Module-5: CASE STUDIES		

Block chain in Financial Service, Supply Chain Management and Government Services	**08**	**Understand**

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

CO 1: Understand the basic concepts and technology used for blockchain.

CO 2: Understand the blockchain architecture and the various mechanisms involved in it.

CO 3: Understand Ethereum block chain contract.

CO 4: Understand the various security features in blockchain technologies

CO 5: Understand the use of smart contracts in real world applications

Reference Books:

1. Narayanan, Bonneau, Felten, Miller, and Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton University Press, **2nd Edition, 2023**
2. Josh Thompson, *Blockchain: The Blockchain for Beginners, Guide to Blockchain Technology and Blockchain Programming*, CreateSpace Independent Publishing Platform, **2nd Edition, 2019**
3. Imran Bashir, *Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained*, Packt Publishing, **3rd Edition, 2022**
4. Merunas Grincalaitis, *Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols*, Packt Publishing, **1st Edition, 2021**

Web links and Video Lectures:

1. https://www.ibm.com/topics/blockchain
2. https://www.investopedia.com/terms/b/blockchain.asp
3. https://builtin.com/blockchain
4. https://youtu.be/SSo_EIwHSd4
5. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design And Use Cases"[MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184

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Department of Information Science & Engineering

Semester: VI

Course Name: INTRODUCTION TO BIG DATA

Course Code: 23ISE1674

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration : 03 Hours**	

Course Learning Objectives: The students will be able to

1	Data Analytics and Decision Making
2	Identify an appropriate probability of the data
3	Show analytical distribution of a system
4	Able to make decisions under Uncertainty
5	Perform testing on estimated data

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.	**08**	**Understand**
Module-2:		
Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. **Hadoop Distributed File System Basics:** HDFS Design Features, Components, HDFS User Commands. **Essential Hadoop Tools:** Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase	**08**	**Understand**
Module-3:		
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	**08**	**Apply**
Module-4:		
Map Reduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.	**08**	**Apply**

Module-5:		
Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web 10 Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:	**08**	**Analyze**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand fundamentals of Big Data analytics
CO 2:	Understand Hadoop framework and Hadoop Distributed File system
CO 3:	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
CO 4:	Understand the MapReduce programming model to process the big data along with Hadoop tools.
CO 5:	Analyze web contents and Social Networks to provide analytics with relevant visualization tools.

Reference Books:

1. Raj Kamal and Preeti Saxena, *Big Data Analytics: Introduction to Hadoop, Spark, and Machine Learning*, McGraw Hill Education, **2nd Edition, 2022**, ISBN: 9789353164966
2. Douglas Eadline, *Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem*, Pearson Education, **1st Edition, 2016**, ISBN13: 9789332570351
3. Tom White, *Hadoop: The Definitive Guide*, 5th Edition, O'Reilly Media, **2015** ISBN-13: 9789352130672
4. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, *Professional Hadoop Solutions*, 1st Edition, Wrox Press, **2014**, ISBN-13: 9788126551071
5. Eric Sammer, *Hadoop Operations: A Guide for Developers and Administrators*, 2nd Edition, O'Reilly Media, **2017**, ISBN-13: 9789350239261
6. Arshdeep Bahga, Vijay Madisetti, *Big Data Analytics: A Hands-On Approach*, 2nd Edition, VPT Publications, **2020**, ISBN-13: 9780996025577

Web links and Video Lectures:

https://onlinecourses.nptel.ac.in/noc20_cs92/preview
https://archive.nptel.ac.in/courses/106/104/106104189/
https://www.digimat.in/nptel/courses/video/106104189/L01.html

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Department of Information Science & Engineering

Semester: VI

Course: Cryptography and Information Security

Course Code: 23ISE161

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

Course Learning Objectives: The students will be able to

1	To apply Cryptographical concepts, and Algorithms.
2	To plan necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.
3	To analyze Information Security Models, threats, and attacks.
4	To compare the legal, ethical and professional issues in Information Security.
5	To analyze the security aspects of Information.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Playfair Cipher,Hill Cipher, Polyalphabetic Ciphers, One-Time Pad, Transposition Techniques. Steganography- Foundations of modern cryptography: Perfect security – Information theory – Product cryptosystem – Cryptanalysis.	**8**	**Apply**
Module-2:		
Mathematics of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclid‟s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- Traditional Block Cipher Structure – Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher Structure, The Feistel Cipher, Block Cipher Design Principles Symmetric key Cipher: DES, Advanced Encryption Standard - Stream Ciphers, RC4.	**8**	**Apply**

Module-3:		
Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem – Exponentiation and logarithm – Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange, Introduction to ElGamal cryptosystem. Cryptographic Hash Functions: Secure Hash Algorithm (SHA) – SHA-512 Logic, SHA-512 Round Function. Digital Signature Standard (DSS).	**8**	**Apply**
Module-4:		
Introduction to Information Security: Introduction, The history of Information Security, what is security? Critical characteristics of Information, CNSS security model, Components of an Information System - The security systems development life cycle. The need for security: Threats and Attacks, Professional, Legal, Ethical Issues in information Security.	**8**	**Analyze**
Module-5:		
Security Analysis: Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk. **Security Technologies:** Introduction, Access Control, Firewalls, Protecting Remote Connections, Intrusion Detection and Prevention Systems – Honeypots, Honeynets and Padded Cell Systems – Scanning and Analysis Tools – Bio metric Access Controls.	**8**	**Analyze**

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

CO1: Apply and understand the fundamental concepts, structures, characteristics, and approaches of encryption techniques, cryptographic functions, key management, and IP security to address the need for effective information security.

CO2: Apply public key and private key cryptosystems, hash functions and key distribution techniques in real-time applications

CO3: Analyze information security risk management frameworks, threat and vulnerability assessment processes, and associated security technologies..

Reference Books:

1. Cryptography and Network Security – Principles and Practice by William Stallings, Person, 8th Edition, 2022.
2. Principles of Information Security, 6th edition, Michael E Whittman, Herbert J Mattord, CENGAGE Learning, 2021.
3. Network Security Essentials Applications and Standards, William Stallings, Pearson, 6th Edition, 2016.
4. Network Security Private Communication in a Public world, Charlie Kaufman, Radia Perlman and Mike Speciner, 3rd Edition, PHI, 2019.
5. Network Security and Management, Brijendra Singh, 3rd Edition, PHI, 2013.

Web links and Video Lectures:

1. https://dl.hiva-network.com/Library/security/Cryptography-and-network-securityprinciples-and-practice.pdf.
2. https://imcs.dvfu.ru/lib.int/docs/Networks/Security/Network%20Security%20Foundati

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Department of Information Science & Engineering

Semester: VI

Course: CLOUD COMPUTING AND ITS APPLICATIONS

Course Code: 23ISE162

L:T:P:J	**2:0:1:0**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**100**
Total Number of Lecture Hours	**40**	**SEA Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	**To introduce** the fundamental concepts of cloud computing, its characteristics, service models, and the evolution from distributed and parallel computing
2	**To provide** an understanding of cloud-enabling technologies, particularly virtualization, and their role in building and managing scalable cloud infrastructure.
3	**To explore** cloud service models (IaaS, PaaS, SaaS), cloud storage technologies, and architectural design principles.
4	**To impart** knowledge on resource management and cloud security mechanisms, and simulate cloud scenarios using appropriate tools.
5	**To familiarize** students with industry-standard cloud platforms such as AWS, Google App Engine, and Aneka, and enable them to develop and deploy cloud-based applications.

Module-1: INTRODUCTION	**No. of hours**	**Blooms cognitive Levels**
Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.	**8**	**Apply**
Module-2: CLOUD-ENABLING TECHNOLOGIES		
Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish? Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices – Virtualization Support and Disaster Recovery. **List of programs:** • Install Virtual box/VMware Workstation with different flavors of Linux or Windows OS on top of windows7 or 8. • Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs.	**8**	**Apply**
Module-3: CLOUD ARCHITECTURE, SERVICES AND STORAGE		
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3. **List of programs:** • Install Google App Engine. Create hello world app and other simple web applications using python/java. • Use GAE launcher to launch the web applications.	**8**	**Apply**

Module-4: RESOURCE MANAGEMENT AND SECURITY IN CLOUD		
Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards. **List of programs:** • Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. Find a procedure to transfer the files from one virtual machine to anothervirtual machine.	**8**	**Apply**

Module-5: CLOUD TECHNOLOGIES AND ADVANCEMENTS		
CLOUD APPLICATION PROGRAMMING AND THE ANEKA PLATFORM: Framework overview, Anatomy of the Aneka container, Building Aneka clouds, Cloud programming and management **INDUSTRIAL PLATFORMS AND NEW DEVELOPMENTS: Amazon web services. Google AppEngine, Microsoft Azure.** **Lab Component:** 7. Design and deploy a web application in a paas 8. Working with Mangra soft Aneka Software 9. AWS lab components are included	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the fundamentals of cloud computing, including its evolution, characteristics, and key enabling technologies such as virtualization and service-oriented architecture
CO 2:	**Install** and **configure** virtualization platforms and cloud services, and **execute** basic cloud applications using tools like VirtualBox, Google App Engine, and Aneka.
CO 3:	**Describe** cloud architecture models (IaaS, PaaS, SaaS), and **analyze** their design challenges and storage solutions.
CO 4:	**Apply** resource management and security concepts in cloud environments, including simulation with CloudSim and implementing cloud security practices.
CO 5:	**Analyze** advanced cloud platforms and technologies such as AWS, Microsoft Azure, and Aneka, and **design** cloud-based applications using these industrial platforms.

Reference Books:

1. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, 2nd Edition, Morgan Kaufmann, 2018.
2. John W. Rittinghouse, James F. Ransome, Cloud Computing: Implementation, Management, and Security, 3rd Edition, CRC Press, 2016.
3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, 1st Edition, Tata McGraw Hill Education, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, 1st Edition, Tata McGraw Hill Education, 2010.
5. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, 1st Edition, O'Reilly Media, 2009.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/106/105/106105167/
2. https://www.youtube.com/watch?v=EN4fEbcFZ_E
3. https://www.guru99.com/cloud-computing-for-beginners.html
4. https://www.simplilearn.com/tutorials/cloud-computing-tutorial

https://www.mygreatlearning.com/cloud-computing/tutorials

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ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
SEMESTER – VI

Course Code: 23ISE163	**L: T:P:J 2:2:2:0**	**CIA: 50**
Credits:	**04**	**SEA: 50**
Total Number of Lecture Hours	**50**	**SEE Duration:03**

Course Learning Objectives: This course will enable students to:

1. Understand and implement foundational machine learning models including concept learning, decision trees, and inductive learning strategies.
2. Apply probabilistic reasoning and Bayesian learning methods to address uncertainty in intelligent systems.
3. Explore the functioning of neural networks and reinforcement learning algorithms for data-driven decision-making.
4. Analyze search algorithms and constraint satisfaction techniques used for solving structured AI problems.
5. Understand the principles of Artificial Intelligence, including intelligent agents and rational behavior in various environments.

Module – 1	**Teaching Hours**	**Blooms cognitive Levels**
What is artificial intelligence (AI)? The foundations of AI, The history of AI, The state of the Art, Intelligent Agents: Agents and Environments, Good Behavior: The concept of Rationality, The nature of the environment, The structure of Agents. **Self Study: Implement different types of agents** Programs:1	**10**	**Apply**
Module – 2		
Solving Problems by Searching: Problem Solving Agents, Example problems, searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic functions, Constraint satisfaction problems: Defining constraint satisfaction problems, Constraint propagation: Inference in CSPs, Local search for CSPs, The structure of problems. **Self Study: Different types of Constraint satisfaction problems** Programs:2,3,4	**10**	**Apply**
Module-3		
Introduction: What is machine learning, Types of Machine learning systems, Well Posed Learning problem, Designing Learning systems, Perspectives and Issues in machine learning, Concept Learning: Concept	**10**	**Apply**

learning task, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm. Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm. **Self study: Factors for Performance ananlysis of different algorithms** Programs:5,6		
Module-4		
Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and least squared error hypotheses, Minimum Description Length Principle, Bayes Optimal Classifier, and Naive Bayes Classifier, Bayesian Belief network, EM Algorithm- General Statements of EM Algorithm. **Self study: Deep Dive into Probabilistic Models and Applications** Programs:7,8,9	**10**	**Apply**
Module-5		
Neural Networks: Introduction, Neural Network Representations, Appropriate problems for Neural Networks, Perceptron's, Multilayer Networks and Back Propagation Algorithms. Reinforcement Learning: Introduction, The learning task, Q-Learning, Nondeterministic rewards and actions, and Temporal difference learning. **Self study: Implementation and Applications of Neural and Reinforcement Learning Models** Programs:10,11	**10**	**Apply**

List of Programs

1) Implement a program to demonstrate simple reflex agents.
2) Implement Best first search.
3) Implement A* Algorithm.
4) Implement Constraint satisfaction problem (CSP)
5) For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
6) Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
7) Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
8) Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
9) Implement EM Algorithm.
10) Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
11) Implement Q-learning algorithm.

Course outcomes: The students will be able to:	
CO1	Understand the fundamental concepts of Artificial Intelligence, including intelligent agents, search strategies, machine learning, probabilistic reasoning, and neural networks.
CO2	Apply various AI algorithms and models such as search strategies, decision trees, Bayesian classifiers, and neural networks to solve real-world problems.
CO3	Apply agent-based and machine learning techniques to develop intelligent systems capable of learning, reasoning, and decision-making.
CO4	Analyze and compare the effectiveness of AI models and learning algorithms in different problem-solving contexts.
CO5	Analyze AI approaches to handle uncertainty and learning in dynamic environments using probabilistic and reinforcement learning models.

Reference Books:

1. **Artificial Intelligence: A Modern Approach**, Stuart Russell, Peter Norvig, 4th Edition, Pearson Education, 2020, ISBN-13: 978-0134610993.
2. **Machine Learning**, Tom M. Mitchell, 1st Edition, McGraw Hill Education, 2017, ISBN-13: 978-12590969521.
3. Artificial Intelligence: A Modern Approach Stuart Russel Peter Norvig Pearson Education 4th edition 2020.
4. Machine Learning Tom M Mitchell McGraw Hill Education, 1st Edition, 2017.
5. Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems Aurelien Geron Shroff/O'Reilly Media 3rd Edition, 2022.
6. Introduction to Machine Learning Ethem Alpaydin PHI Learning Pvt. Ltd 4th Edition, 2020.
7. Structures and Strategies for Complex Problem-Solving George FLuger Pearson Education 5th Edition, 2011.

WEB links and Video Lectures

1.https://cloud.google.com/learn/artificial-intelligence-vs-machine-learning

2.https://onlinecourses.nptel.ac.in/noc19_me71/preview

3.https://youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&feature=shared

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SEMESTER - VI

Virtual and Augmented Reality

Course Code	23ISE164	CIA Marks	50
Teaching Hours/Week (L:T:P:J)	0:0:2:2	SEA Marks	50
Total Number of Lecture Hours	25	Exam Hours	03
Credits	2		

Course Learning Objectives:

- Experience the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR
- Demonstrate the Geometric Modelling Techniques Review the Virtual Environment
- Develop VR/AR Technologies Simulate and Apply Virtual/Augmented Reality to varieties of Applications.

	Number of Hours	**Bloom's Level**
Module 1		
Blender Introduction • Demonstrate Blender Interface, Overlay Reference, Position on Overlay, Managing Layouts, Camera Overlay • Demonstrate Scene view navigation, Scene view camera, Game View. • Project Creation, Plane creation, cube creation, Explanation of cube camera and position, Material Selection, and class file same, adding motion to the script, Run. • Understanding different 3D projectiles	**4+ 2(Project)**	**Apply**
Module 2		
Blender Programming • Show the use of blender for Creating, loading and saving the scenes. • Demonstrate the Transforms, Components, 3D objects, creating components, Saving the work. • Demonstrate the Layers, Constraints, Editor Feature 3d mode, Preferences, Build settings, Sculpting, preference add Ons	**4+ 2(Project)**	**Apply**
Module 3		
Graphics • Demonstrate the use of Render Pipelines, Cameras, lighting, models, mirroring objects • Demonstrate the use of Meshes, Textures, shaders, materials • Demonstrate the concept Visual effects, sky, colour for suitable example. • Demonstrate the concept of World Building, Terrain, tree Editor for suitable example. • Demonstrate Creation of left-hand, left-hand Controller and right-hand controller.	**4+ 2(Project)**	**Apply**

Module 4		
Scripting, Audio Video and Animation • Demonstrate the Setting up scripting Environment. • Apply the concepts for Creating frames, creating .mkv files, namespaces, attributes • audio files, tracker Modules, Audio Group inspector. • Demonstrate for suitable example to create Animation, Rotation in animation, animation clips, Humanoid avatars, Animation.	**4+ 2(Project)**	**Apply**
Module 5		
Augmented reality • Program to show augmented reality. • Program to show The Relationship Between Augmented Reality and Other Technologies-Media, Technologies. • Program to show Spectrum Between Real and Virtual Worlds, applications of augmented reality Augmented.	**4+ 2(Project)**	**Create**

Mini project

- Using VR exploring the human body level by level, including cell level.
- Using VR describing how medicine and body cures the illness.
- Touchless ATM Using Augmented Reality.
- Augmented Reality Controlled Hologram.
- Augmented Reality House devices.
- Augmented Reality Agriculture Field.
- Augmented Reality and Medical devices.
- VR Game Development.
- VR Application Development.
- Development of AI controlled VR Device, that accurately work to keep the clarity very good and using technology keep the eye healthy.
- Development of Cardboard VR device as activity.
- Improvising the quality of the VR Device and determining the accuracy.
- Development of Satellite with the capability of VR Camera and more features.
- Ability to view the Solar system using the VR Device using compatible camera sent through the satellite.

Course Outcomes:

The students will be able to

- Apply navigation skills and utilize the Blender interface to create and manipulate basic 3D objects, integrating materials, textures, and basic animations
- Apply programming techniques in Blender for creating and managing 3D scenes using transformations, constraints, layers, and XR integration
- Use advanced graphics features such as render pipelines, shaders, lighting, world-building, and XR controllers to develop immersive virtual environments
- Develop scripting environments to create animations, integrate audio/video elements, and produce realistic humanoid avatars and dynamic scenes.
- Design and construct functional Augmented Reality applications, and explore AR's relationship with other technologies through innovative real-world mini-projects

References:

1. Gregory C. Burdea & Philippe Coiffet, Virtual Reality Technology, 3rd Edition, Wiley-IEEE Press, 2024, ISBN 978-1394306947
2. Allan Fowler, AR Game Development, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178
3. Allan Fowler, Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178
4. Donald D. Hearn, M. Pauline Baker & Warren Carithers, Computer Graphics with OpenGL, 4th Edition, Pearson Education, 2011, ISBN 978-0136053583
5. Unity Manual – Scripting Documentation (2023.2)
6. Steven M. LaValle, Virtual Reality, Cambridge University Press, 2023, ISBN 978-1107198937
7. William R. Sherman & Alan B. Craig, Understanding Virtual Reality: Interface, Application, and Design, 2nd Edition, Morgan Kaufmann Publishers, 2018, ISBN 978-0128010389

Professional Elective – 1

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Semester: VI

Course: Data Mining

Course Code: 23ISE1651

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours	**40**	**SEA Duration:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the principles of Data warehousing and Data Mining
2	Be familiar with the Data warehouse architecture and its Implementation
3	Classify and predict the given data for the application development

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Data modelling: Basic Concepts- A multitier Architecture, Data warehouse models**:** Enterprise warehouse- Data mart and virtual warehouse, Extraction, Transformation and loading- Data Cube: A multidimensional data model- Stars, Snowflakes and Fact constellations: Schemas for multi dimensional Data models- Dimensions: The role of concept Hierarchies- Measures: Their Categorization and computation, Typical OLAP Operations.	**8**	**Understand**
Module-2:		
Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture of A Typical Data Mining Systems- Classification of Data Mining Systems. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining	**8**	**Understand**
Module-3:		
Association Analysis :- Association Analysis: Problem Definition- Frequent Item set Generation- Rule generation- Alternative Methods for Generating Frequent Item sets- FP-Growth Algorithm- Evaluation of Association Patterns	**8**	**Apply**
Module-4:		
Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis	**8**	**Analyze**

Case Study: Customer Segmentation of E-Commerce data using Clustering Algorithms		

Module-5:		
Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web **Case Study:** Interpreting Twitter Data from ongoing technical developments in country Tweets	**8**	**Analyze**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the principles of Data Modeling
CO 2:	Understand the principles of Data Mining
CO 3:	Apply the concepts of association analysis
CO 4:	Analyze the concepts of various clusters
CO 5:	Analyze the concepts of spatial and multimedia mining

Reference Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson Education, 2021.
2. Jiawei Han, Jian Pei, Hanghang Tong, Data Mining: Concepts and Techniques, 4th Edition, Elsevier (Morgan Kaufmann), 2022.
3. Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining & OLAP, 3rd Edition, McGraw Hill Education, 2015.
4. K.P. Soman, Shyam Diwakar, V. Ajay, Insight into Data Mining Theory and Practice, 2nd Edition, Prentice Hall of India, 2019.
5. G. K. Gupta, Introduction to Data Mining with Case Studies, 2nd Edition, PHI Learning, 2017.

Web links and Video Lectures:

1. https://www.udemy.com/topic/data-warehouse/
2. https://www.coursera.org/professional-certificates/microsoft-azure-dp-203-data-engineering
3. https://www.edx.org/learn/data-warehouse
4. https://alison.com/tag/data-mining

https://www.datacamp.com/courses/introduction-to-data-warehousing

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Semester: VI

Course: BlockChain Technologies: Platforms and Applications

Course Code: 23ISE1652

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Apply the basic concepts of blockchain technology.
2	Applications of Blockchain and its technologies for bitcoin and cryptocurrencies.
3	Demonstrate the functioning of smart contracts with the help of Ethereum 101.
4	Apply the concept of hyperledger for creation of distributed and personalized blockchains.
5	Build and Implement blockchain technology for real world applications.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Blockchain: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, **Self Study: Benefits and limitations of blockchain.** **Decentralization and Cryptography:** Decentralization using blockchain, Cryptography and Technical and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys	**L :08**	**Apply**
Module-2:		
Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payment B: Alternative Coins, Theoretical foundations, **Self Study** :**Bitcoin limitations**, Namecoin, Litecoin, Primecoin, Zcash.	**L : 07**	**Analyze**
Module-3:		
Smart Contracts and Ethereum 101: Smart Contracts: Definition: Ricardi contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum of the Ethereum blockchain, Precompiled contracts.	**L : 07**	**Create**
Module-4:		
Introduction to Hyperledger: What is Hyperledger? **Self Study** :**Distributed Ledger Technology & its Challenges**, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.	**L : 07**	**Apply**
Module-5:		
Applications of Blockchains: Alternative block chain**:** Blockchain-Outside-of Currencies, Internet of Things, Government, Finance, Media, **Self Study Medical Record Management System, Domain Name Service and Future of Blockchain.**	**L : 07**	**Analyze**

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

CO1 Apply the principles of decentralized architectures, cryptography, and distributed ledgers to analyze and evaluate different blockchain models and their technical foundations.
CO2 Analyze and evaluate the operational mechanisms of Bitcoin, Ethereum, smart contracts, and Hyperledger frameworks to determine suitable platforms for various real-world applications.
CO3 Design and create blockchain-based solutions for domains such as IoT, finance, governance, healthcare, and digital identity by integrating appropriate consensus mechanisms, smart contracts, and cryptographic techniques.

Reference Books:

1. Imran Bashir, Mastering Blockchain: Distributed Ledgers, Decentralization and Smart Contracts Explained, 4th Edition, Packt Publishing Ltd, 2023, ISBN 978-1803241067.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, 1st Edition, Princeton University Press, 2016.
3. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, 1st Edition, Apress, 2017.
4. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 3rd Edition, O'Reilly Media, 2023.
5. Nitin Gaur, Anthony O'Dowd, Petr Novotny, Luc Desrosiers, Venkatraman Ramakrishna, Salman A.Baset, Blockchain with Hyperledger Fabric, 2nd Edition, Packt Publishing, 2020, ISBN 978-1839218750.

Web links and Video Lectures:

1. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/

2. Udemy: https://www.udemy.com/course/build-your-blockchain-az/

https://eduxlabs.com/courses/blockchain-technology- training/?tab=tab-curriculum

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SEMESTER – VI

Course: Cyber Security

Course Code: 23ISE1653

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Total Number of Lecture Hours	**40**	**SEA Duration : 03 Hours**

Course Learning Objectives: The students will be able to

1	**To provide** a foundational understanding of computer security principles, threats, vulnerabilities, and essential security mechanisms like authentication, access control, and cryptography.
2	**To expose** students to various cyber threats targeting systems, networks, and users, and enable them to apply mitigation techniques across different platforms.
3	**To introduce** digital forensics tools and techniques, and equip students with knowledge and practical skills in cybercrime investigation, evidence collection, and analysis.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: What Is Computer Security? Threats, Harm, Vulnerabilities, Controls, Conclusion, What's Next? **Toolbox:** Authentication, Access Control, and Cryptography: Authentication, Access Control.	**8**	**Apply**
Module-2:		
The Web—User Side: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. **Operating Systems:** Security in Operating Systems, Security in the Design of Operating Systems, Rootkit.	**8**	**Apply**
Module-3:		
Networks: Network concepts, War on Networks: Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service.	**8**	**Apply**
Module-4:		
Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.	**8**	**Analyze**

Module-5:		
Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies, Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.	**8**	**Analyze7**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	**Explain** key concepts of computer security, including threats, vulnerabilities, access control, and cryptography.
CO 2:	**Apply** techniques to detect and mitigate cyber threats in operating systems, networks, web applications, and email systems.
CO 3:	**Analyze** digital forensic methods, cybercrime investigation techniques, and evidence handling processes using forensic tools.

Reference Books:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 6th Edition, Pearson Education, 2022.
2. NIIT, Understanding Forensics in IT, Latest Edition, NIIT Publishing, 2020 (Note: Exact edition/year may vary, newer editions not widely available).
3. Nelson Phillips, Enfinger Steuart, Computer Forensics and Investigations, 5th Edition, Cengage Learning, 2023.
4. John Sammons, Michael Cross, The Basics of Cyber Safety: Computer and Mobile Device Safety Made Easy, 2nd Edition, Elsevier, 2021.
5. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Cybersecurity Essentials, 3rd Edition, Wiley, 2023.
6. Imran Bashir, Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, 2nd Edition, Packt Publishing, 2018.
7. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, 1st Edition, Princeton University Press, 2016.

Web links and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://www.slideshare.net/Siblu28/cyber-security-36922359
3. https://www.geeksforgeeks.org/cyber-security-types-and-importance/
4. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#

Udemy: https://www.udemy.com/course/build-your-blockchain-az/

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Semester: VI

Course: Data Visualization

Course Code: 23ISE1654

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours	**40**	**SEA Duration:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Understand and describe the main concepts of data visualization, chart types and their recommended usage.
2	Create data visualizations and dashboards using Tableau Desktop
3	Identify the latest dashboard and reporting features of Microsoft Power BI
4	Make Use of data from multiple sources, create stunning visualizations
5	Identify the capabilities of Power BI mobile applications

Descriptions (if any):

Prerequisite

- Working knowledge of Programming Language.
- Windows or Apple O.S.
- CPUs must support SSE4.2 and POPCNT instruction sets
- Citrix environments, Microsoft Hyper-V, Parallels, and VMware.

Module-1:	**No. of hours**	**Blooms Cognitive Levels**
Introduction: Introduction to data visualization, Getting started with Tableau Desktop, Connecting to the tutorial dataset, Creating the charts. **Common charts**: Creating common visualizations (bar charts, line charts etc.), Filtering and sorting data, Adding Titles, Labels, and descriptions, Publish your work to Tableau Cloud.	**8**	**Understand**
Module-2:		
Interactions: Interactivity with text and visual tooltips, Interactivity with actions (filter, highlight, URL), Assembling dashboards from multiple charts. **Transform the data:** Creating simple calculations in Tableau**,** Using table calculations**,** Introduction to Tableau Preparation.	**8**	**Apply**
Module-3:	**No. of hours**	**Blooms Cognitive Levels**
Preparing Data Sources: Query folding, Query design per dataset mode, Import mode dataset queries, Direct Query dataset queries, Direct Query report execution, Composite datasets, and Table storage modes. **Data Sources:** Authentication, Data Source settings, Privacy levels, Power BIas a data source, Power BI Desktop options, Global options, Current FILE options.	**8**	**Apply**

Module-4:		
SQL views: SQL views versus M queries, SQL view examples, Date dimension view, Mark as date table, Product dimension view, Slowly changing dimensions. **Designing Dashboards:** Dashboard design, Visual selection, Layout, Navigation pane, Full screen mode, supporting tiles	**8**	**Apply**
Module-5:		
Dashboard Architecture Single dashboard Architecture, Multiple dashboard Architecture, Organizational Dashboard Architecture, Multiple datasets. **Dashboard Tiles:** Tile details and custom links, Real time data tiles, Dashboard themes**,** Mobile optimized dashboards	**8**	**Apply**

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

CO1: Understand and describe the main concepts of data visualization, chart types and their recommended usage.

CO2:Create data visualizations and dashboards using Tableau Desktop

CO3:Identify the latest dashboard and reporting features of Microsoft Power BI

CO4:Make use of data from multiple sources, create stunning visualizations

CO5:Identify the capabilities of Power BI mobile applications

Reference Books:

1. Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios, 1st Edition, Wiley, 2017.
2. Greg Deckler, Brett Powell, Leon Gordon, Mastering Microsoft Power BI: Expert Techniques to Create Interactive Insights for Effective Data Analytics and Business Intelligence, 2nd Edition, Packt Publishing, 2022.
3. Ryan Sleeper, Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, 1st Edition, O'Reilly Media, 2018.
4. Ben Fry, Visualizing Data: Exploring and Explaining Data with the Processing Environment, 1st Edition, O'Reilly Media, 2008.
5. Julie Steele, Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, 1st Edition, O'Reilly Media, 2011.

Web links:

- https://powerbi.microsoft.com
- https://www.tableau.com
- https://www.udemy.com/course/data-visualization-dashboard-design
- https://www.insightplatforms.com/10-free-tools-dashboards-data-visualization-infographics

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: UI Frameworks

Course Code: 23ISE1655

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits	**03**	**SEA**	**: 50**
Total Number of Lecture Hours	**40**	**SEA Duration**	**:03 Hours**

Course Learning Objectives: The students will be able to

1	To understand the Front-end Web UI Framework.
2	To understand the essence of Bootstrap grid system and responsive design.
3	To understand the various Bootstrap CSS components
4	To understand the various Bootstrap Java script components
5	To understand the concept of Bootstrap and JQuery Web Tools

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Front-end Web UI Frameworks Overview: Front-End Web UI Frameworks and Tools: Bootstrap 4, How to Use the Learning Resources, What is Full-Stack Web Development? Setting up Git, Basic Git Commands, Online Git Repositories, Front-end Web UI Frameworks.	**8**	**Understand**
Module-2:		
Introduction to Bootstrap: Getting Started with Bootstrap, Responsive Design, Bootstrap Grid System, Responsive Design and Bootstrap Grid System.	**8**	**Understand**
Module-3:		
Bootstrap CSS Components: Navigation and Navigation Bar, Navbar and Breadcrumbs, Icon Fonts, Icon Fonts, User Input, Buttons, Forms, Bootstrap Tables and Cards, Displaying Content: Tables and Cards, Images and Media, Alerting Users.	**8**	**Apply**
Module-4:		
Bootstrap Javascript Components: Bootstrap JavaScript Components, Tabs, Pills and Tabbed Navigation, Tabs, Collapse and Accordion, Accordion, Tooltips, Popovers and Modals, Tooltips and Modals, Carousel.	**8**	**Apply**
Module-5:		
Web Tools: Bootstrap and JQuery, More Bootstrap and JQuery, CSS Preprocessors: Less and Sass, Less, Scss, Building and Deployment, Task Runners, Grunt, Web UI Frameworks.	**8**	**Apply**

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

CO 1:Understand the Front-end Web UI Framework and basic Git commands

CO 2:Understand the Bootstrap grid system and responsive design

CO 3:Develop an application using bootstrap CSS components

CO4:Develop an application using bootstrap Javascript Components

CO5:Building and Deployment of applications

Reference Books:

1. Chong Lip Phang, Mastering Front-End Web Development: 14 Books in 1. Introducing 200+ Extensions. An Advanced Guide, 1st Edition, Independently Published, 2020.
2. Benjamin Jakobus, Jason Marah, Mastering Bootstrap 4, 2nd Edition, Packt Publishing, 2018.
3. Matt Lambert, Learning Bootstrap 4, 2nd Edition, Packt Publishing, 2016.
4. Riwanto Megosinarso, Step By Step Bootstrap 3: A Quick Guide to Responsive Web Development Using Bootstrap 3, 1st Edition, CreateSpace Independent Publishing, 2014.
5. Jennifer Kyrnin, Bootstrap in 24 Hours, Sams Teach Yourself, 1st Edition, Pearson Education, 2015.

Web links and Video Lectures:

1. https://coursesity.com/course-detail/front-end-web-ui-frameworks-and-tools-bootstrap-4
2. https://medium.com/swlh/front-end-web-ui-frameworks-and-tools-bootstrap-4-fb3906d885ff
3. https://getbootstrap.com/docs/5.3/getting-started/introduction/
4. https://www.youtube.com/watch?v=-qfEOE4vtxE

https://www.youtube.com/watch?v=eow125xV5-c

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course: Strategic Management

Course Code: 23ISE1656

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	To provide a framework for students to understand strategic management concepts and conduct external analysis for competitive advantage.
2	To help students develop a thorough understanding of principles and models related to an organization's internal analysis.
3	To help students understand the different strategy options available for organizations in a complex and dynamic environment.

Module-1: Introduction to Strategic Management and External Analysis	**No. of hours**	**Blooms cognitive Levels**
Meaning and Characteristics of Strategic Management; The Strategic Management Process. **External Analysis**– PESTLE analysis, Environment Threat and Opportunity Profile (ETOP); Industry Analysis –Porter's Dominant Economic Features, Porter's Five Forces Model, Strategic Group Mapping; Industry Key Success Factors, Key Performance Indicators and Key Result Areas.	**8**	**Apply**
Module-2: Internal Analysis		
Strategic Vision, Mission, Goals, Long-Term and Short-Term Objectives and their Value to the Strategic Management Process; Organizational Capability Profile – Resource Based View of the firm (RBV) and VRIN; Business Portfolio Analysis – BCG / Growth Share Matrix, GE 9 Cell Model; Balanced Score Card, SWOC Analysis, Value Chain Analysis, Benchmarking.	**8**	**Apply**
Module-3: Strategy Formulation		
Corporate Strategies: Growth Strategies – Internal Growth, External Growth (Integration, Diversification, Mergers, Joint Ventures, Strategic Alliances), Product/Market Expansion grid / Ansoff's Matrix; Stability Strategies – NoChange, Profit and Proceed with Caution.	**8**	**Apply**
Module-4:Strategy Implementation		
Facilitators for implementation of strategy: Organisational Structures – matching structure to strategy, McKinsey's 7S, Changing structure and processes (Business Process Reengineering, Six Sigma); Strategic Leadership; Organisational Culture – Learning organisations, MBO, TQM.	**8**	**Apply**

Module-5: Strategic Control		
Focus of Strategic Control, Establishing Strategic Controls (Premise Control, Strategic Surveillance, Special Alert Control, Implementation Control), Exerting Strategic Control (through Competitive Benchmarking, Performance and Formal and Informal Organisations).	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand strategic management concepts and how to conduct external analysis for competitive advantage.
CO 2:	Apply selected models of internal analysis to evaluate an organization.
CO 3:	Understand and analyse the different strategy options available for organizations in a complex and dynamic environment.
CO 4:	Appreciate the essential factors in strategy implementation.
CO 5:	Understand how to establish and exert strategic control.

Reference Books:

1. Stewart Clegg, Chris Carter, Martin Kornberger, Jochen Schweitzer, Strategy: Theory and Practice, 3rd Edition, SAGE Publications, 2020.
2. John A. Parnell, Strategic Management: Theory and Practice, 7th Edition, Academic Media Solutions, 2025.
3. Arthur A. Thompson Jr., Margaret A. Peteraf, John E. Gamble, A. J. Strickland III, Arun K. Jain, Crafting and Executing Strategy: The Quest for Competitive Advantage – Concepts and Cases, 23rd Edition, McGraw Hill Education, 2024.

Web links and Video Lectures:

1.https://www.edx.org/learn/strategic-management
2.https://www.youtube.com/watch?v=ZmRK9wc3hjI
3. https://ipbusinessacademy.org/wp-content/uploads/2021/02/Lecture-NotesPart1.pdf

Professional Elective – 2 (MOOC Course)

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course Name: Natural Language Processing

Course Code: 23ISE1661

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	To learn the fundamentals of natural language processing
2	To understand the use of CFG and PCFG in NLP
3	To understand the role of semantics of sentences and pragmatics
4	To apply the NLP techniques to IR applications
5	Compare and contrast the use of different statistical approaches for different types of NLP applications

Module-1: Introduction	**No. of hours**	**Blooms cognitive Levels**
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance	**8**	**Understand**
Module-2: Word Level Analysis		
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.	**8**	**Apply**
Module-3: Syntactic Analysis		
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.	**8**	**Apply**
Module-4: Semantics and Pragmatics		
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.	**8**	**Apply**

Module-5: Discourse Analysis and Lexical Resources		
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	To tag a given text with basic Language features
CO 2:	To design an innovative application using NLP components
CO 3:	To implement a rule based system to tackle morphology/syntax of a language
CO 4:	To design a tag set to be used for statistical processing for real-time applications
CO 5:	To compare and contrast the use of different statistical approaches for different types of NLP applications.

Reference Books:

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 3rd Edition 2025.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O_Reilly Media, 2009.
3. Breck Baldwin, ―Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
4. Richard M Reese, ―Natural Language Processing with Java‖, O_Reilly Media,2nd Edition 2018.
5. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
6. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

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Department of Information Science & Engineering

Semester: VI

Course Name: NoSQL

Course Code: 23ISE1662

L:T:P:J	**3:0:0:0**	**CIA**	**:**	**50**
Credits:	**03**	**SE**	**:**	**50**
Total Number of Lecture Hours	**40**	**SEA Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Compare different types of NoSQL Databases
2	Compare and contrast RDBMS with different NoSQL databases.
3	Demonstrate the detailed architecture Document-oriented NoSQL databases.
4	Explain performance tune of Key-Value Pair NoSQL databases.
5	Apply Nosql development tools on different types of NoSQL Databases.

Module-1: Why NoSQL	**No. of hours**	**Blooms cognitive Levels**
Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points	**8**	**Understand**
Module-2: Aggregate and Distributed Data model		
Aggregate, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. Replication and sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.	**8**	**Apply**
Module-3: Document Databases		
Document oriented 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, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	**8**	**Apply**
Module-4: Column-Family Store and Key-Value Databases		
Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage. Key-Value Database: Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases.	**8**	**Apply**

Module-5: Graph Databases	**No. of hours**	**Blooms cognitive Levels**
Graph Databases, Graph Database. Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases. Graph NoSQL databases using Neo4, NoSQL database development tools and programming languages. NoSQL Key/Value databases using MongoDB.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand different types of NoSQL Databases.
CO 2:	Compare Relational Database to NoSql stores and explain Sharding and Replication
CO 3:	Illustrate the Document-oriented NoSQL databases
CO 4:	Understand column oriented NoSql Database.
CO 5:	Understand detailed architecture of Graph NoSQL databases and apply Nosql Development tools with suitable usecase.

Reference Books:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019.

Web Reference:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/.
4. https://www.javatpoint.com/nosql-database

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Department of Information Science & Engineering

SEMESTER – VI

Course Name: Operation Research

Course Code: 23ISE1663

L:T:P:J	**3:0:0:0**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration**	**:**	**03Hours**

Course Learning Objectives: The students will be able to

1	To understand the methodology of OR problem solving and formulate linear programming problem.
2	Describe numerous problem-solving approaches for optimization.
3	Solve linear programming problems using simplex method, Big M method 2- phase method.
4	Identify the problems of transportation and assignment problem, and then solve it.
5	Use game theory as a case study in a decision support system.

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction, Linear Programming: Introduction: The origin, nature and impact of OR; Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation . Introduction to Linear Programming Problem (LPP): Prototype Example Assumption of LPP, Formulation of LPP and Graphical Method Various Examples.	**8**	**Understand**
Module-2:		
Simplex Method–1: The essence of the simplex method; Setting up the simplex method; Types of variables, Algebra of the simplex method; the simplex method in tabular form; Tiebreaking in the simplex method, BigM method, Two phase method.	**8**	**Apply**
Module-3:		
Simplex Method–2: Duality Theory-The essence of duality theory, Primal dual relationship, conversion of primal to dual problem and viceversa. The dual simplex method.	**8**	**Apply**
Module-4:		
Transportation and Assignment Problems: The transportation problem, Initial Basic Feasible Solution (IBFS) by North West Corner Rule method, Matrix Minima Method, Vogel's Approximation Method. Optimal solution by Modified Distribution Method (MODI).The Assignment problem; A Hungarian algorithm for the assignment problem. Minimization and Maximization varieties in Transportation and assignment problems.	**8**	**Apply**

Module-5:	No. of hours	Blooms cognitive Levels
Game Theory: Game Theory: The formulation of two persons, zero sum games; saddle point, maximin and minimax principle, Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
CO 2:	Determine optimal strategy for products using various methods
CO 3:	Solve linear programming problems using duality theory and post optimality analysis
CO 4:	Understand the given problem as transportation and assignment problem and solve.
CO5:	Illustrate game theory for decision support system.

Reference Books:

1. D.S. Hira, P.K. Gupta, Operations Research, Revised Edition, S. Chand & Company Ltd, 2018.
2. S. Kalavathy, Operations Research, 4th Edition, Vikas Publishing House Pvt Ltd, 2010.
3. S.D. Sharma, Operations Research, 13th Edition, Kedar Nath Ram Nath Publishers, 2019.
4. Kantiswaroop, P.K. Gupta, Man Mohan, Operations Research, 4th Revised Edition, Sultan Chand & Sons, 2016.
5. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operations Research, 10th Edition, McGraw-Hill Education, 2014.

Web links and Video Lectures:

1. https://archive.nptel.ac.in/courses/112/106/112106134/#
2. http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/techniq.htm
3. https://indiafreenotes.com/operations-research-techniques/
4. https://nptel.ac.in/courses/110106062
5. https://onlinecourses.nptel.ac.in/noc22_ma48/preview

B.N.M. Institute of Technology

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Department of Information Science & Engineering

Semester: VI

Course Name: Deep Learning

Course Code: 23ISE1664

L:T:P:J	**3:0:0:0**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Introduce to deep learning algorithms and their applications in order to solve real problems.
2	Understand the concepts of deep learning, including neural networks, activation functions, and the learning process.
3	Gain experience in deploying deep learning models to solve practical problems.

Module-1: Introduction	**No. of hours**	**Blooms cognitive Levels**
Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, **stochastic gradient descent,** momentum, and adaptive sub-gradient method.	**8**	**Understand**
Module-2: Neural Networks		
Feedforward neural networks, deep networks, **regularizing a deep network**, model exploration, and hyper parameter tuning.	**8**	**Understand**
Module-3: Convolution Neural Networks		
Introduction to convolution neural networks: stacking, **striding and pooling,** applications like image, and text classification.	**8**	**Apply**
Module-4: Sequence Modeling		
Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architecture deep recurrent networks, **LSTM networks**.	**8**	**Apply**
Module-5: Autoencoders		
Undercomplete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders..	**8**	**Apply**

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

CO 1:	Understand the architecture and working principles of feed-forward and deep neural networks, including their components, activation functions, and training mechanisms.
CO 2:	Design and implement single-layer and multi-layer deep neural networks, and tune hyper-parameters such as learning rate, batch size, number of layers, and activation functions to solve real-world problems.
CO 3:	Analyze the performance of deep neural networks using evaluation metrics, and interpret the impact of architectural choices and training parameters on model accuracy and efficiency.

Reference Books:

1. Bunduma, N., Fundamentals of Deep Learning, 1st Edition, 2017.
2. Heaton, J., Deep Learning and Neural Networks, Heaton Research Inc., 2nd Edition, 2017.
3. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, MIT Press, 1st Edition, 2016.
4. Deng, L., Yu, D., Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing), Now Publishers, 1st Edition, 2014.
5. Hall, M.L., Deep Learning, VDM Verlag, 1st Edition, 2011.

B.N.M. Institute of Technology

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SEMESTER – VI

Course: Agile Software Development

Course Code: 23ISE1665

L:T:P:J	**3:0:0:0**	**CIA**	**:**	**50**
Credits:	**03**	**SEA**	**:**	**50**
Total Number of Lecture Hours:	**40**	**SEA Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	To understand how an iterative, incremental development process leads to faster delivery of more useful software
2	To understand the essence of agile development methods
3	To understand the principles and practices of extreme programming
4	To understand the roles of prototyping in the software process
5	To understand the concept of Mastering Agility

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Agile: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, **How to Be Agile?:** Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor	**06**	**Understand**
Module-2:		
Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, **Adopting XP:** Is XP Right for Us?, Go!, Assess Your Agility.	**06**	**Understand**
Module-3:		
Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, **Collaborating:** Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand- Up Meetings, Coding Standards, Iteration Demo, Reporting, **Releasing:**"Done Done", No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation, **Planning:** Vision, Release Planning, The Planning Game, Iteration Planning, Slack, Stories, Estimating, **Developing:** Incremental Requirements, Customer Tests, Test-Driven Development, Refactoring, Simple Design, Incremental Design and Architecture, Spike Solutions.	**08**	**Analyze**

Module-4:		
Mastering Agility: Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, **Improve the Process:** Understand Your Project, Tune and Adapt, Break the Rules, **Rely on People:** Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, **Eliminate Waste:** Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput.	**08**	**Analyze**
Module-5:		
Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, **Seek Technical Excellence:** Software Doesn't Exist, Design Is for Understanding, Design Tradeoffs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery.	**08**	**Analyze**

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

CO 1: Understand the essence of agile development methods

CO 2: Understand The XP Lifecycle, XP Concepts, Adopting XP

CO 3: Analyze the Work on Pair Programming, Root-Cause Analysis, Retrospectives, Planning, Incremental Requirements, Customer Tests

CO 4: Analyze the concept of Mastering Agility

CO 5: Analyze the principles and practices of extreme programming

Reference Books:

1. **The Art of Agile Development** by James Shore and Shane Warden, 2nd Edition, published by O'Reilly Media in November 2021.
2. **Agile Software Development: Principles, Patterns, and Practices** by Robert C. Martin, 1st Edition, published by Prentice Hall in 2002.
3. **Agile and Iterative Development: A Manager's Guide** by Craig Larman, 1st Edition, published by Addison-Wesley in 2004.
4. **Essential Scrum: A Practical Guide to the Most Popular Agile Process** by Kenneth S. Rubin, 1st Edition, published by Addison-Wesley Professional in July 2012.
5. **Scrum: The Art of Doing Twice the Work in Half the Time** by Jeff Sutherland and J.J. Sutherland, 10th Anniversary Edition, published by Random House Business Books in 2024.

Web links and Video Lectures:

1. https://www.techtarget.com/searchsoftwarequality/definition/agile-software-development
2. https://www.atlassian.com/agile/kanban
3. https://www.atlassian.com/agile/scrum
4. https://www.simplilearn.com/tutorials/agile-scrum-tutorial/what-is-agile

https://www.youtube.com/watch?v=WjwEh15M5Rw

B.N.M. Institute of Technology

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Department of Information Science & Engineering

Semester: VI

Course Name: Knowledge Management

Course Code: 23ISE1666

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration: 03Hours**

Course Learning Objectives: The students will be able to

1	Understand the basics of knowledge creation and knowledge capture
2	Understand the mechanics of knowledge management
3	Understand the use of knowledge management strategy and application of KM tools

Module-1: Introduction	**No of hours**	**Blooms cognitive Levels**
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.	**8**	**Apply**
Module-2: Creating The Culture Of Learning And Knowledge Sharing		
Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.	**8**	**Apply**
Module-3: Knowledge Management-The Tools		
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Mana gement - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information	**8**	**Apply**
Module-4: Knowledge Management-Application		
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).	**8**	**Apply**

Module-5: Future Trends and Case Studies		
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategicand business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand the basics of knowledge management
CO 2:	Understand and apply knowledge management models
CO 3:	Understand the mechanics of knowledge management
CO 4:	Understand and implement knowledge management strategy and knowledge management tools
CO 5:	Understand and apply ICT tools for effective knowledge management

Reference Books:

1. Srikantaiah, T.K., Koenig, M., *Knowledge Management for the Information Professional*, Information Today, Inc., **2nd Edition, 2014**
2. Nonaka, I., Takeuchi, H., *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, **Reprint Edition, 2021**
3. Frances Horibe, *Managing Knowledge Workers*, John Wiley & Sons, **Updated Edition, 2018**
4. Fernandez & Leidner, *Knowledge Management*, PHI Learning, New Delhi, **2nd Edition, 2017**
5. Ganesh Natarajan and Sandhya Shekhar, *Knowledge Management - Enabling Business Growth*, Tata McGraw Hill, **Revised Edition, 2016**
6. Elias M. Awad & Hassan M. Ghaziri, *Knowledge Management*, Pearson Education, **2nd Edition, 2004**

Web links and Video Lectures:

1.What is Knowledge Management? https://www.youtube.com/watch?v=3_eI5r55XhU 2.Knowledge Management and Innovationhttps://www.youtube.com/watch?v=DNUwZctwwhw

Open Elective

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Department of Information Science & Engineering

Semester: VI

Course Name: Introduction to Data Science

Course Code: 23ISE1671

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration : 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand data collection and pre-processing techniques for data science
2	Identify fundamentals of R language and statistics
3	Utilize Iterative programming and functions in R for data handling.
4	Identify complex statistical operations using lists and data frames in R
3	Apply Data Reduction and Visualization Techniques

Module-1	**No. of hours**	**Blooms cognitive Levels**
Introduction to Data Science Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model.	**8**	**Understand**
Module-2		
Basics of R: Introduction, R Environment Setup, Programming with R, Basic Data Types. Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode.	**8**	**Apply**
Module-3		
Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data. Conditionals and Control Flow: Relational Operators, Logical Operators. Iterative Programming in R: Introduction, While Loop, For Loop.	**8**	**Apply**

Module-4		
Functions in R: Introduction, writing a Function in R, Nested Functions, Function Scoping, Loading an R Package, Mathematical Functions in R, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames. Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements.	**8**	**Apply**
Module-5		
Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.	**8**	**Apply**

Course Outcomes: After completing the course, the students will be able to
CO1: Understand data collection and pre-processing techniques for data science.
CO2: Identify fundamentals of R language and statistics.
CO3: Utilize Iterative programming and functions in R for data handling.
CO4: Identify complex statistical operations using lists and data frames in R.
CO5: Apply Data Visualization Techniques.

Reference Books:

1. O'Neil, Cathy and Rachel Schutt, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly, **2013**
2. K G Srinivas, G M Siddesh, *Statistical Programming in R*, Oxford University Press, **Latest edition 2021**
3. Jiawei Han, Micheline Kamber, and Jian Pei, *Data Mining: Concepts and Techniques*, 3rd Edition, The Morgan Kaufmann Series in Data Management Systems, **3rd Edition, 2011**
4. Anand Rajaraman and Jeffrey D. Ullman, *Mining of Massive Datasets*, Cambridge University Press, **2nd Edition, 2014**
5. Joel Grus, *Data Science from Scratch*, Shroff Publishers / O'Reilly Media, **2nd Edition, 2019**
6. Andy Kirk, *Data-Driven Design: A Handbook for Data Visualization and Communication*, **Latest Edition, 2023**

Web links and Video Lectures:

1. https://www.javatpoint.com/r-tutorial
2. https://nptel.ac.in/courses/106106179
3. https://nptel.ac.in/courses/111104147
4. https://nptel.ac.in/courses/111104146
5. https://nptel.ac.in/courses/128106002

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Department of Information Science & Engineering

Semester: VI

Course Name: Software Testing

Course Code: 23ISE1672

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the importance of software testing fundamentals, methodologies, and tools.
2	Apply the knowledge of software testing strategies and methodologies for various types of testing
3	Identify the various types and testing strategies to find bugs in the software.
4	Investigate test planning and its management.
5	Demonstrate the usage of modern testing tools to write automation script

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Basics of Software Testing: Basic definitions, Software Quality, Requirements, Behavior and Correctness, Correctness versus Reliability, Testing and Debugging, Test cases, identifying test cases, Test-generation Strategies, Test Metrics, Error and fault taxonomies, Levels of testing, Testing and Verification, Static Testing, the triangle problem, commission problem, the SATM (Simple Automatic Teller Machine) problem.	**08**	**Understand**
Module-2:		
Functional Testing: Boundary value analysis, Robustness testing, Worst-case testing, Robust Worst testing for triangle problem, Nextdate problem and commission problem, Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, and the commission problem, Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem.	**08**	**Apply**
Module-3:		
Types and levels of Testing: Unit Testing: Driver, Stub **Integration Testing:** Top-Down integration, Bottom-up Integration, Bi-Directional Integration **Testing on Web application**: Performance Testing, Load testing, stress Testing, security Testing, Client-server Testing **Acceptance Testing:** Alpha Testing and Beta Testing, special Tests: Regression Testing, GUI Testing.	**08**	**Apply**

Module-4:		
Test Management: Test Planning: Preparing a test plan, Deciding Test approach, setting up criteria for testing, identifying responsibilities, Staffing, Resource Requirements, Test Deliverables, Testing Tasks. **Test Management:** Test infrastructure management, Test People Management **Test process:** Base Lining a test plan, Test case specification Test Reporting: Executing Test cases, Preparing Test summary Report.	**08**	**Apply**
Module-5:		
Testing Tools and Measurements: Manual Testing and need forautomation testing tools, advantages, and disadvantages of using tools,selecting a testing tool, when to use automated testing tools, testing using automated tools. Metrics and Measurement: Types of metrics, product metrics and process metrics, object-oriented metrics in testing.	**08**	**Apply**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the importance of software testing fundamentals, methodologies, and tools
CO2	Apply the knowledge of software testing strategies and methodologies for various types of testing.
CO3	Analyze various types of testing and identify bugs to create defect report of given application.
CO4	Explore test planning and its management.
CO5	Explore testing software for performance measures using automated testing tools.

Reference Books:

1. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing: Principles and Practices*, Pearson India, **2nd Edition, 2019**, ISBN: 9789352606510
2. Limaye M.G., *Software Testing: Principles, Techniques and Tools*, Tata McGraw Hill, **Latest Edition, 2018**
3. Paul C. Jorgensen, *Software Testing: A Craftsman's Approach*, 4th Edition, CRC Press (Auerbach Publications), **2013**
4. Naresh Chauhan, *Software Testing: Principles and Practices*, Oxford University Press, **2nd Edition, 2017**
5. Yogesh Singh, *Software Testing*, Cambridge University Press, Bengaluru, **1st Edition, 2019**, ISBN 978110765278X

Web links and Video Lectures:

1. http://www.selenium.com
2. https://nptel.ac.in/courses/106/105/106105150/
3. https://nptel.ac.in/courses/106/101/106101163/
4. www.toolsqa.com
5. http://en.wikipedia.org/wiki/Test_automation

http://en.wikipedia.org/wiki/Software_testing#Testing_tools

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Department of Information Science & Engineering

Semester: VI

Course Name: Introduction to Blockchain

Course Code: 23ISE1673

L:T:P:J	**3:0:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the emerging abstract models for Blockchain Technology
2	Familiarize with the functional/operational aspects of crypto currency eco-system
3	Understand the security issues in block chain

Module-1: INTRODUCTION TO BLOCKCHAIN	**No. of hours**	**Blooms cognitive Levels**
Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.	**08**	**Understand**
Module-2: BLOCKCHAIN ARCHITECTURE		
Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)	**08**	**Understand**
Module-3: Ethereum basics: BLOCKCHAINS IN BUSINESS		
Public versus private and permissioned versus permission less blockchains Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain- as-a-Service- Initial Coin Offering (ICO) Ethereum and Smart Contracts	**08**	**Understand**
Module-4: PRIVACY, SECURITY ISSUES IN BLOCKCHAIN		
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks	**08**	**Understand**
Module-5: CASE STUDIES		
Block chain in Financial Service, Supply Chain Management and Government Services	**08**	**Understand**

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

CO 1: Understand the basic concepts and technology used for blockchain.

CO 2: Understand the blockchain architecture and the various mechanisms involved in it.

CO 3: Understand Ethereum block chain contract.

CO 4: Understand the various security features in blockchain technologies

CO 5: Understand the use of smart contracts in real world applications

Reference Books:

1. Narayanan, Bonneau, Felten, Miller, and Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton University Press, **2nd Edition, 2023**
2. Josh Thompson, *Blockchain: The Blockchain for Beginners, Guide to Blockchain Technology and Blockchain Programming*, CreateSpace Independent Publishing Platform, **2nd Edition, 2019**
3. Imran Bashir, *Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained*, Packt Publishing, **3rd Edition, 2022**
4. Merunas Grincalaitis, *Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols*, Packt Publishing, **1st Edition, 2021**

Web links and Video Lectures:

1. https://www.ibm.com/topics/blockchain
2. https://www.investopedia.com/terms/b/blockchain.asp
3. https://builtin.com/blockchain
4. https://youtu.be/SSo_EIwHSd4
5. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design And Use Cases"[MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184

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Department of Information Science & Engineering

Semester: VI

Course Name: Introduction To Big Data

Course Code: 23ISE1674

L:T:P:J	**3:0:0:0**	**CIA : 50**
Credits:	**03**	**SEA : 50**
Total Number of Lecture Hours**:**	**40**	**SEA Duration : 03 Hours**

Course Learning Objectives: The students will be able to

1	Data Analytics and Decision Making
2	Identify an appropriate probability of the data
3	Show analytical distribution of a system
4	Able to make decisions under Uncertainty
5	Perform testing on estimated data

Module-1:	**No. of hours**	**Blooms cognitive Levels**
Introduction: Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.	**08**	**Understand**
Module-2:		
Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. **Hadoop Distributed File System Basics:** HDFS Design Features, Components, HDFS User Commands. **Essential Hadoop Tools:** Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase	**08**	**Understand**
Module-3:		
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	**08**	**Apply**
Module-4:		
Map Reduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.	**08**	**Apply**

Module-5:		
Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web 10 Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:	**08**	**Analyze**

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand fundamentals of Big Data analytics
CO 2:	Understand Hadoop framework and Hadoop Distributed File system
CO 3:	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
CO 4:	Understand the MapReduce programming model to process the big data along with Hadoop tools.
CO 5:	Analyze web contents and Social Networks to provide analytics with relevant visualization tools.

Reference Books:

1. Raj Kamal and Preeti Saxena, *Big Data Analytics: Introduction to Hadoop, Spark, and Machine Learning*, McGraw Hill Education, **2nd Edition, 2022**, ISBN: 9789353164966
2. Douglas Eadline, *Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem*, Pearson Education, **1st Edition, 2016**, ISBN13: 9789332570351
3. Tom White, *Hadoop: The Definitive Guide*, 5th Edition, O'Reilly Media, **2015** ISBN-13: 9789352130672
4. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, *Professional Hadoop Solutions*, 1st Edition, Wrox Press, **2014**, ISBN-13: 9788126551071
5. Eric Sammer, *Hadoop Operations: A Guide for Developers and Administrators*, 2nd Edition, O'Reilly Media, **2017**, ISBN-13: 9789350239261
6. Arshdeep Bahga, Vijay Madisetti, *Big Data Analytics: A Hands-On Approach*, 2nd Edition, VPT Publications, **2020**, ISBN-13: 9780996025577

Web links and Video Lectures:

https://onlinecourses.nptel.ac.in/noc20_cs92/preview
https://archive.nptel.ac.in/courses/106/104/106104189/
https://www.digimat.in/nptel/courses/video/106104189/L01.html