GOVERNMENT OF INDIA
MINISTRY OF
PARLIAMENTARY AFFAIRS

Azadi Ka Amrit Mahotsav

mygov मेरी सरकार

PREAMBLE TO THE CONSTITUTION

PREAMBLE

WE, THE PEOPLE OF INDIA,

having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC **REPUBLIC** and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity;

and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this 26th day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

I have read the Preamble

[redacted]

Signature

23-01-2022

SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

("Deemed to be University u/s 3 of the UGC Act, 1956")
Accredited 'A+' Grade by NAAC
Agalakote, B.H.Road, Tumkur – 572 107.KARNATAKA, INDIA.

No. SSAHE/ACA-S&C/32/UG(BE)/2024 Date: 15/07/2024

N O T I F I C A T I O N

Sub: - Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (2nd Year Information Science and Engineering)

Ref: Proceedings of the Academic Council meeting held on 10/07/2024 vide agenda No. SSAHE/AC/XXVIII-12/2024

In exercise of the powers vested under section 6 of 6.05 of MoA / Rules of SSAHE, the Revised Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (2nd Year Information Science and Engineering) is notified herewith as per Annexure.

By Order,

REGISTRAR

REGISTRAR
Sri Siddhartha Academy of Higher Education
TUMKUR - 572 107, Karnataka.

To,
Dean / Principal, Sri Siddhartha Institute of Technology,

Copy to
1) Office of the Chancellor, SSAHE, for kind information,
2) PA to Vice-Chancellor / PA to Registrar / Controller of Examinations / Finance Officer, SSAHE
3) All Officers of the Academy Examination Branch / Academic Section
4) Guard File / Office copy.

S.S.A.H.E TUMKUR

Department of Information Science and Engineering

(Accredited by NBA from 2022-25)

Vision of the Department

"To impart knowledge to young aspirants to develop Information Technology based solutions for the Industrial and Societal needs".

Mission of the Department

- Prepare students to acquire knowledge in the field of Information Technology through effective teaching learning methodologies.
- Establish conducive environment for better learning through the state of the art curriculum to exhibit talents and ingenuity.
- Nurture the students to be industry ready by enhancing their employability skills and entrepreneurial skills.
- Develop Information Technology based solution as per the need of Society.

Program Educational Objectives (PEOs)

- Analyse, design and develop Information Technology based solutions using suitable platforms.
- Accomplish any tasks with ethical values and commitment to meet the societal problems.
- Inculcate team work capabilities and managerial skills to become entrepreneur or employee of an organization.
- Instil lifelong learning capabilities and to pursue higher education and research.

Program Outcomes (POs)

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. Able to apply appropriate techniques for storage of huge amount of data and ensuring its integrity.
2. Choose appropriate method for data acquisition from real world and propose suitable solutions to solve problems.

SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU

(A constituent College of Siddhartha Academy of Higher Education, Tumakuru)

Academic Year 2024-25

Scheme of Teaching and Examination-2022 (160 Credits Scheme, NEP)

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

III Semester B.E.

Sl No.	*Course Code*		*Course Title*	*Teaching Dept.*	*L*	*T*	*P*	*Credits*	*CIE*	*SEE*	*Total Marks*	*Exam Hrs*
01	BS	22SS301	Statistics and Probability	MA	3	-	0	3	50	50	100	3
02	PC	22IS302	Data Structures and its Applications	IS	3	-	0	3	50	50	100	3
03	PC	22IS303	Operating Systems	IS	3	-	2	4	50	50	100	3
04	PC	22IS304	Python for Data Processing	IS	3	-	2	4	50	50	100	3
05	PC	22IS305	Digital Design and Computer Organization	IS	3	-	-	3	50	50	100	3
06	PC	22IS306	Dept. Skill Lab - I (Data Structures Lab)	IS	1	-	2	2	50	50	100	3
07	HS	22SK307	Skill Development - I	T&P	1	-	-	1	50	-	50	-
08	HS	22HS308	Constitution of India	HS	1	-	-	1	50	-	50	-
L-Lecture, T-Tutorial, P-Practical,/Drawing, CIE-continuous Internal Evaluation, SEE-Semester End Examination				**Total**	**18**	**-**	**6**	**21**	**400**	**300**	**700**	**-**
Credits Distribution: Basic Science (BS)=08+08+3=19, Engineering Science (ES)=10+11=21, Humanities & Social Sciences (HS)=1+2=03, Program Core (PC)=02+16=18, Total Credits=20+20+21=61.												

Department: Mathematics			**Semester:**	**III**
Subject: Statistics and Probability (Common to AI&ML, CR CS, DS and IS)				
Subject Code:	**22SS301**		**L – T – P - C:**	**3–0–0–3**

Sl. No	Course Objectives
1	Introduce the concept of correlation and regression and fitting of a curve.
2	Apply discrete and continuous probability distributions for single and two variables in analyzing the probability models arising in engineering field.
3	To understand the concepts of the stochastic process of a statistic and estimation of parameters
4	Develop analytical capability and to impart knowledge of Probability, Statistics and Queuing

Unit	Description	Hrs
I	**Statistical Methods:** Correlation and regression- Karl Pearson's coefficient of Correlation, Regression analysis- lines of regression (without proof), rank correlation, problems. **Curve fitting:** Curve fitting by the method of least squares- Fitting of the straight line, second degree parabola and exponential form of the curve $y = ab^x$ (All results without proof) –Problems.	**08**
II	**Probability Distributions:** Review of basic probability theory**.** Random variables (Discrete and Continuous), Probability of mass/density functions, Binomial distribution, Poisson's distribution, Exponential distribution and Normal distribution (without derivations) and problems.	**08**
III	**Joint probability distributions**: Joint probability distribution for discrete random variables, Mathematical expectations, Covariance and Correlation. **Analysis of variance:** Definition and properties, one way classification, verification within and between treatments.	**07**
IV	**Markov Chain:** Probability Vector, Stochastic Matrix, Regular Stochastic Matrix, definition of Markov Chain, Transition Probabilities and Transition probability Matrix, Higher Transition Probabilities, state transition diagram, stationary distribution of regular Markov chains, problems. **Queuing theory**: Introduction, Concepts and M/G/1 and M/M/1 queuing systems, problems.	**09**
V	**Sampling and Statistical Inference:** Sampling distributions, Concepts of hypothesis, standard error and confidence interval, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests. Z-test: for single mean, for single proportion. Student's t – distribution, Chi-square test for goodness of fit.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the concepts of Curve Fitting, Correlation, Regression, probability distribution and Markov chain.
CO2	Formulate and solve mathematical problems on probability distribution, sampling theory, queuing theory and analysis of variance.
CO3	Analyze the behaviour of Markov chain-based problems in the long run and compute the correlation, regression lines, covariance of random variables using joint probability.
CO4	Apply the concepts of Analysis variance, testing of hypothesis, Markov chain, Probability distributions and queuing theory models in engineering fields.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2												
CO3	3	3	1									1		
CO4	3	3	2	2								1		

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Higher Engineering Mathematics	B.S.Grewal	43rd Edition Khanna Publications, 2015. ISBN:9788174091956
2	Introduction to Probability Models	Sheldon M. Ross	Elsevier, 9th edition, 2007

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Probability, Random Variables and Stochastic Process	Athanosios Papoulis & S. Unnikrishna Pillai	Tata McGraw Hill, 4th edition, 2002.
2	Higher Engineering Mathematics	B.V.Ramana	1st Edition, TataMcGraw-Hill,2006. ISBN:9780070634190

Department: Information Science and Engineering			**Semester:**	**III**
Subject: Data Structures and its Applications				
Subject Code:	**22IS302**		**L – T – P – C:**	**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Know different methods of storing data in memory and its access.
2	Learn different types of data structures.
3	Understand non-linear data structures and its applications.
4	Arranging of data in an orderly fashion and perform search operation.

Unit	Description	Hrs
I	**Introduction:** Elementary Data Organization, Data structures, Data Structures Operations. **Arrays, Structures and Pointers:** Traversing linear arrays, Inserting and deleting, Multidimensional arrays, Introduction to structure data type, Accessing Structure members, Self-referential structure, pointer and arrays, pointer and structure.	**08**
II	**Linked Lists and Stack:** Introduction, Dynamic Memory allocation, Linked lists, Insertion, Deletion, Traversing, Searching a linked list, Header Node and its significance. **Stack:** Introduction to Stack, operations on Stack, Linked representation of Stack.	**08**
III	**Applications of Stack, Queue:** Arithmetic expressions, Polish notation, Recursion, Towers of Hanoi, **Queue:** Operations on Queue, Circular Queue, Dequeue, Priority queue, and Linked representation of Queue.	**08**
IV	**Trees:** Introduction, Binary trees, Representing binary trees in memory, Traversing binary trees, Binary Search Trees, Searching, Inserting and Deleting in a Binary Search Tree.	**08**
V	**Sorting and searching:** Introduction, Bubble sort, Insertion sort, Selection sort, Linear search, Binary search. **Graphs and their applications:** Graph theory terminology, Sequential representation of graphs; Adjacency matrix; Path matrix, Traversing a graph.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Outline different types of data structures.
CO2	Choose suitable data structures for a given problem.
CO3	Perform operations on data structure.
CO4	Apply concepts of data structures to develop solution for various applications.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3											2		
CO2	3	3	3	2								2		
CO3	2	2	3	2	2									
CO4	1	2	2	2	2									

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Data Structures with C (Schaum`S Outline Series)	Seymour Lipschutz	Tata McGraw-Hill Education Pvt. Ltd. ISBN 10 - 0070701989 ISBN 13 - 9780070701984

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Data Structure using C	Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein	1st Edition, Pearson publication, 2019, ISBN-13: 9789332543546.
2	Data Structures: A Pseudocode Approach with C	Richard F. Gilberg and Behrouz A. Forouzan	Cengage Publication, 2007, ISBN-13: 9788131503140

Department: Information Science and Engineering	**Semester:**	**III**

Subject: Operating Systems				
Subject Code:	**22IS303**		**L – T – P - C:**	**3 – 0 – 2 – 4**

Sl. No	Course Objectives
1	Know various design approach and services provided by an operating system.
2	Understand how the processes and memory is managed.
3	Learn the structure and organization of the file system and storage management.
4	Use system calls to develop program for processes, memory and file management.

Unit	Description	Hrs
I	**Introduction to Operating Systems and System Structures:** What operating systems do; Computer System architecture; Operating System structure; Kernel Data Structures; Computing Environments. **Operating System Structures:** System calls; Types of system calls; System programs; Operating System structure.	**08**
II	**Process Management:** Process concept; Process scheduling; Operations on processes; Inter process communication. Threads concept; Overview; Multithreading models; Threading issues. Process Scheduling basic concepts; Scheduling criteria; Scheduling algorithms.	**08**
III	**Process Synchronization:** Introduction; The Critical section problem; Peterson's solution; mutex lock: Semaphores; Classical problems of synchronization; Monitors. **Process deadlocks**: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention and avoidance; Deadlock detection; recovery from deadlock.	**08**
IV	**Memory Management:** Introduction; Swapping; Contiguous memory allocation; Segmentation; Paging; Structure of page table; Virtual Memory concept; Demand paging; Copy-on write; Page replacement; Allocation of frames; Thrashing.	**08**
V	**Secondary Storage Structures:** Disk structure; Disk scheduling; Disk management; **File System Interface:** File concept; Access methods; Directory structure; File protection. **File System Implementation:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. **Protection:** Goals of protection, Principles of protection, Domain of protection, Access matrix.	**08**

LAB CONTENT

Sl. No	Experiment Description
1	a. Write a program using fork () system call that creates a child process. The child process prints its own pid, id of its parent, does directory listing (using exec () system call) and exits. The parent process has to invoke wait () system call to wait for child process to complete and prints its own pid and id of its child process and then exists. b. Write a program to demonstrate the basic Pthreads API for constructing a multithreaded program that calculates the summation of a non-negative integer in a separate thread.
2	Develop two programs (server and client) that illustrate the passing of a string via shared memory between the processes running simultaneously. The server program creates the shared memory portion and string. The client program attaches itself to the created shared memory portion and uses the string.
3	Design, develop and execute a program to simulate the working of Shortest Job First scheduling algorithm. Compute and print the average waiting time and average turnaround time. Draw the Gantt chart, calculate the average waiting time and average turnaround time manually and compare the results.
4	Design, develop and execute a program to simulate the working of Round Robin Scheduling algorithm with different Quantum sizes. Compute and print the average waiting time and average turnaround time. Draw the Gantt chart, calculate the average waiting time and average turnaround time manually and compare the results.
5	Implement the Producer-Consumer problem with bounded buffer using semaphores.
6	Design, develop and run a program to implement the Banker's Algorithm. Demonstrate its working with different data values.
7	Implement Best fit Memory management scheme.
8	Implement LRU Page Replacement Algorithm.
9	Implement Disk Scheduling Algorithms like: FCFS, SSTF, and SCAN.
10	Implement file allocation on free disk space in a contiguous manner.

Course Outcomes:

Course outcome	Descriptions
CO1	Outline various options and issues involved while designing an operating system.
CO2	Explain the various functionalities of operating systems.
CO3	Apply appropriate techniques for managing the resources of computer.
CO4	Select a better solution from a set of possible solutions to solve a problem.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			1										
CO2	3													
CO3		3												
CO4			3	2										

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Operating System Principles	Peter Baer Galvin, Greg Gagne	10th Edition, Wiley-India, 2019. ISBN: 978-1119454083

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Operating Systems Internals and Design Principles	William Stallings	9th Edition Pearson education India March 2018.

Department: Information Science and Engineering	**Semester:**	**III**

Subject: Python for Data Processing				
Subject Code:	**22IS304**		**L – T – P - C:**	**3 – 0 – 2 – 4**

Sl. No	Course Objectives
1	Acquire the programming skills in core python.
2	Understand the functionalities available in Python libraries.
3	Familiarize with rich data structures of Python to work with structured data in fast, easy and expressive way.
4	Learn data cleaning and preparation tools for data analysis.

Unit	Description	Hrs
I	**Python Language Basics:** The Python Interpreter, Python Language Basics: Language Semantics, Scalar Types, Control Flow. Functions: Namespaces, Scope, and Local Functions, Returning Multiple Values, Functions Are Objects, Anonymous (Lambda) Functions.	**08**
II	**Built-in Data Structures, Functions, and Files:** Data Structures and Sequences: Tuple, List, Built-in Sequence Functions, dict, set, List, Set, and Dict Comprehensions, Currying: Partial Argument Application, Generators, Errors and Exception Handling.	**08**
III	**NumPy Basics:** Arrays and Vectorized Computation: The NumPy ndarray: A Multidimensional Array Object: Creating ndarrays, Data Types for ndarrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes, Universal Functions: Fast Element-Wise Array Functions, Mathematical and Statistical Methods, Methods for Boolean Arrays, Sorting, Unique and Other Set Logic, File Input and Output with Arrays, Linear Algebra, Pseudorandom Number Generation.	**08**
IV	**Getting started with pandas:** Introduction to pandas Data Structures: Series, Data Frame, Index Objects, Essential Functionality: Reindexing, Dropping Entries from an Axis, Indexing, Selection, and Filtering, Integer Indexes, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Summarizing and Computing Descriptive Statistics: Unique Values, Value Counts, and Membership.	**08**
V	**Data Loading, Storage, and File Formats, Data Cleaning and Preparation:** Reading and Writing Data in Text Format: Reading Text Files in Pieces, Writing Data to Text Format, Working with Delimited Formats, Handling Missing Data, Data Transformation, String Manipulation.	**08**

LAB CONTENT

Sl. No	Experiment Description
1	Write a program to convert temperature to and from Celsius to Fahrenheit.
2	Write a script named copyfile.py. This script should prompt the user for the names of two text files and copy the contents of the first file to the second file.
3	Write a program to create, append and remove elements in list.
4	Write a Program to Count Occurrences of an element in a list.
5	Write a program to get a list of even numbers from a given list of numbers. (Use only comprehensions).
6	Write a program to generate an infinite number of even numbers (Use generator).
7	Write a python program as a function which takes as parameter a tuple of string (s, s1) and which returns the index of the first occurrence of s1 found within the string s. The function must returns -1 if s1 is not found within the string s. Example if s = "Python Programming" and s1 = "thon", the function returns the index 2.
8	Write a program to read text file data and create a dictionary of all keywords in the text file. The program should count how many times each word is repeated inside the text file and then find the keyword with a highest repeated number. The program should display both the keywords dictionary and the most repeated word.
9	Using a numpy module create an array and check the following: a) type of an array b) axis of an array c) shape of an array d) type of elements in an array.
10	Using a numpy module create array and check the following: a) List with type float b) 3*4 array with all zeros c) From tuple d) Random values.
11	Using a numpy module create array and check the following: a) Reshape 3X4 array to 2X2X3 array b) Sequence of integers from 0 to 30 with steps of 5 c) Flatten array d) Constant value array of complex type.
12	Implement the following using numpy module a) Creation of Arrays b) Demonstrate indexing in numpy array c) Demonstrate basic arithmetic operations on single array
13	Using numpy module implement the following a) Replace items that satisfy a condition without affecting the original array b) Get the positions where elements of two arrays match c) Compute the row wise counts of all possible unique values in an array
14	Write a python code to read a csv file using pandas module and print the first and last five lines of a file.
15	Write a Pandas program a) To create and display a DataFrame from a specified dictionary data which has the index labels. b) To select the specified columns and rows from a given DataFrame. c) To rename columns of a given DataFrame. d) To drop a list of rows from a specified DataFrame.

16	Write a Pandas program a) To reset index in a given DataFrame. b) To detect missing values of a given Data Frame. Display True or False. c) To replace NaNs with median or mean of the specified columns in a given Data Frame.

Course Outcomes:

Course outcome	Descriptions
CO1	Illustrate the syntax and semantics of the python programming.
CO2	Develop programs to solve real world problems using Python.
CO3	Apply numpy and pandas tools to work with numerical and tabular array data.
CO4	Utilize the set of tools to manipulate data into the right form for data Analysis.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		1											
CO2		1	3											
CO3			2		3							2		
CO4	1		1		3							2		

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Python for Data Analysis	Wes McKinney	2nd Edition, O'Reilly Media, ISBN: 978-1-491-95766-0, 2018

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Data Analytics using Python	Bharti Motwani	Wiley Publications, June 2020, ISN-13: 978-8126502950,

Department: Information Science and Engineering			**Semester:**	**III**
Subject: Digital Design and Computer Organization				
Subject Code:	**22IS305**		**L – T – P - C:**	**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Learn and analyze basic Digital design principles, logic circuit design.
2	Simulate digital circuits using Verilog coding.
3	Understand various machine instruction, input/output, memory and peripherals in digital computer.
4	Learn the arithmetic and logic unit and implementation of fixed-point and Floating point arithmetic unit.

Unit	Description	Hrs
I	**Combinational Logic Circuits:** Sum-of-Products Method, Truth Table to Karnaugh Map, Karnaugh Simplifications, Don't-care Conditions, Sums-of-Product, Product-of-Sums Simplification. **Data Processing Circuits:** Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD-to-decimal Decoders, Encoder. HDL Implementation models and Implementation of Data Processing Circuits.	**08**
II	**Flip-Flops:** Flip-Flops and RS, D, JK, T Flip-Flop, Edge-Triggered Flip-Flops, Various Representations of Flip-Flops. **Registers & Counters:** Registers, Counters, Design of Synchronous Counters. HDL Implementation of Flip-Flops, Registers, Counters.	**08**
III	**Basic Structure of Computers:** 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. **Input/output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access, Buses. Standard I/O Interfaces.	**08**
IV	**Basic Process unit**: Fundamental Concepts: Register Transfers, Performing an Arithmetic or Logic operation, Fetching a word from Memory, Storing a word in Memory. Execution of complete Instruction: Branch Instructions. Multiple-Bus Organization, Hardwire Control, Multiprogrammed Control.	**08**
V	**Arithmetic:** Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating-point Numbers and Operations.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Able to Analyze the working of Digital circuits.
CO2	Design digital circuit to solve a given problem.
CO3	Outline the internal design and functioning of central processor unit.
CO4	Describe the interaction of I/O devices with central processor unit.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	2	3				2	3	3	3		
CO2	3	3	3	2	3				3	3	3	3		
CO3	1	3	1	2	1									
CO4	1	1	1	2	1									

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Digital Principles and Applications	Malvino and Leach	8th Edition, McGraw Hill Education,2014 ISBN- : 978-9339203405
2	Computer Organization	Carl Hamachar and Zvonko Vranesic	5th Edition, McGraw Hill Education,2011 ISBN-13 978-1259005275

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Digital Principles and Design	Donald D. Givone	1st Edition, McGraw-Hill Publishers, 2017, ISBN-13: 9780070529069.
2	Computer Organization And Architecture Designing For Performance	William Stallings	11th Edition, Pearson, 2019, ISBN 9780134997193.

Department: Information Science and Engineering	**Semester:**	**III**

Subject: Data Structures Lab				
Subject Code:	**22IS306**		**L – T – P - C:**	**1 – 0 – 2 – 2**

Sl. No	Course Objectives
1	Develop skills to design and analyze simple linear and nonlinear data structures.
2	Strengthen the ability to identify and apply suitable data structure for the given real world problem.
3	Gain knowledge in practical applications of data structures.
4	Learn to develop a code for various applications using data structures.

LAB CONTENT

Sl. No	Experiment Description
Cycle 1	**PART A** **Structures, Pointers and memory representation of records:** Write a C programs to implement: 1. Record structure of an employee. 2. Complex number operations using structures. 3. Create an array using pointer. 4. Access an element from an array using pointer. 5. Find the sum of all the elements of array using pointer.
Cycle 2	**Linked Lists:** Write a C programs to: 6. Implement linked list as a Stack. 7. Implement linked list as a Queue. 8. Check whether two given lists are containing the same data. 9. Find the largest element in a given linked list. 10. Search the given a node present in the linked list. 11. Insert or Delete a new node at a given position in the linked list. **Stacks, Queues and their Applications:** Write a C programs to implement: 12. Stack operations. 13. Tower of Hanoi using recursion. 14. Factorial of a given number using recursion. 15. Fibonacci series using recursion. 16. Convert a number from decimal to binary using recursion. 17. Reverse a given array of elements using recursion. 18. Simple queue operations. 19. Circular queue operations. 20. Priority queue operation.

Cycle 3	**Trees, Sorting and Searching:** Write a C programs to: 21. Implement binary search tree operations. 22. Search an element in an array using binary search. 23. Arrange the list of numbers in ascending order using bubble sort. 24. Arrange the list of numbers in ascending order using insertion sort.
Cycle 4	**Programs for self-practice:** Write C programs to: 25. Implementing the following graph traversal algorithms: a. Depth First Traversal b. Breadth First Traversal 26. Count the number of nodes in the binary search tree. 27. Sort a given list of strings.
Cycle 5	**Mini Project:** Students will develop a mini project using the appropriate data structures for various applications. Few applications for references are: 1. Make a Phone Book using data structure. 2. Encryption and decryption of file content. 3. Implement the undo function. 4. Record the sequence of all the pages browsed in one session. 5. Implement printer spooler so that jobs can be printed in the order of their arrival. 6. Implement back functionality in the internet browser. 7. Represent an image in the form of a bitmap. 8. Huffman coding 9. Design a calculator. 10. Representing a city region telephone network. 11. Store a set of programs which are to be given access to a hard disk according to the priority. 12. Binary Tree (Graphical Implementation) 13. Bitmap Image Compression. 14. Word frequency finder. **Note: Any other applications can also considerable.**

Course Outcomes:

Course outcome	Descriptions
CO1	Use appropriate data structures in program development.
CO2	Apply data structures like stacks and queues to solve problems.
CO3	Implement the concept of linked lists in solving problems.
CO4	Design and implement solutions for different applications using data structures.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2		3									
CO2	2	3	3		3									
CO3	2	3	3		3									
CO4	2	3	3	2	3	1	1	1	3	3		2		

Pattern for practical exam conduction:

Mini project is considered for evaluation of both CIE and SEE. In Semester End Practical Examination, students are allowed to execute one program from the given list of programs and mini project demo.

Department: Training and Placement			**Semester:**	**III**
Subject: Skill Development-I				
Subject Code:	**22SK307**		**L – T – P - C:**	**1-0-0-1**

Sl. No	Course Objectives
1	Improve Communication Skills: Enhance students' ability to express ideas clearly, listen actively, and adapt communication style to different contexts and audiences.
2	Foster Effective Teamwork: Develop students' teamwork skills, including cooperation, active participation, conflict resolution, and leveraging diverse strengths for collaborative success.
3	Enhance Leadership Abilities: Cultivate leadership qualities by helping students develop self-awareness, problem-solving skills, and decision-making abilities
4	Promote Professional Etiquette: Instill a sense of professionalism in students, emphasizing appropriate workplace behavior, business etiquette, and ethical conduct.

Unit	Description	Hrs
I	**Communication Skills**: Basics, Method, Means, Process and Purpose, Basics of Business Communication, Written & Oral Communication, Listening. Communication with Confidence & Clarity- Interaction with people, the need the uses and the methods, Getting phonetically correct, using politically correct language, Debate & Extempore.	**06**
II	**Assertive Communication-**Concept of Assertive communication, Importance and applicability of Assertive communication, Assertive Words, being assertive. **Presentation Skills-**Discussing the basic concepts of presentation skills, Articulation Skills, IQ & GK, How to make effective presentations, body language & Dress code in presentation, media of presentation	**05**
III	**Team Work**: Team Work and its important elements Clarifying the advantages and challenges of team work Understanding bargains in team building Defining behavior to sync with team work Stages of Team Building Features of successful teams. **Body Language & Proxemics**: Rapport Building - Gestures, postures, facial expression and body movements in different situations, Importance of Proxemics, Right personal space to maintain with different people.	**05**

IV	**Group discussion, Motivation and Stress Management** a. Theory & Evaluation: Understanding why and how is the group discussion conducted. b. Techniques of group discussion c. Discussion on FAQs of group discussion d. Body language during group discussion Self-motivation, group motivation, leadership abilities, Stress clauses and stress busters to handle stress and de-stress; Understanding stress - Concept of sound body and mind, Dealing with anxiety, tension, and relaxation techniques. Individual Counseling & Guidance, Career Orientation. Balancing Personal & Professional Life	**06**
V	**Interview Skills, Professional Practice** a. Personal and Group Interviews b. Mock Interviews - Questions asked & how to handle them c. Body language in interview d. Etiquette, Dress code in interview e. Behavioral and technical interviews f. Practice on stress interviews, technical interviews, General HR interviews **Professional Practice**: Professional Dress Code, Time Sense, Respecting People & their Space, Relevant Behavior at different Hierarchical Levels. Positive Attitude, Self-Analysis and Self-Management. Professional Ethics values to be practiced, standards and codes to be adopted as professional engineers in the society for various projects. Balancing Personal & Professional Life	**06**

Course Outcomes:

COs	Descriptions
CO1	Improved Communication Skills: Students will demonstrate enhanced verbal and written communication abilities, effectively expressing ideas, actively listening, and adapting their communication style to different situations.
CO2	Effective Teamwork and Collaboration: Students will exhibit improved teamwork skills, actively contributing to group projects, resolving conflicts constructively, and leveraging the strengths of team members to achieve shared goals.
CO3	Professional Etiquette and Conduct: Students will display professional behavior, adhering to workplace etiquette, demonstrating appropriate appearance, punctuality, and practicing ethical conduct in professional settings.
CO4	Strengthened Aptitude Skills: Students will demonstrate improved aptitude skills, including logical reasoning, analytical thinking, and problem-solving abilities, enabling them to excel in competitive exams, interviews, and real-life problem-solving scenarios

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1					2		3	3	3				
CO2	1					2		3	3	3				
CO3	1					2		3	3	3				
CO4	1					2		3	3	3				

Text Books: Nil

Reference Books:

Sl No	Reference book title	Author	Volume and Year of Edition
1	Technical Communication Principles and Practices,	Meenakshi Raman and Sangeeta Sharma,	Oxford Publishers, 2004
2	Tools for Talking When Stakes are High	Kerry Patterson, Joseph Grenny, Ron McMillan, Crucial Conversation	McGraw-Hill Publication, ISBN: 9780071772204

Department: Humanity Science			**Semester:**	**III**
Subject: Constitution of India				
Subject Code:	**22HS308**		**L – T – P - C:**	**1-0-0-1**

Sl. No	Course Objectives
1	To be familiar with salient features and preamble of the constitution of India. Including fundamental rights of the citizen of India and types of Fundamental rights
2	To understand the relevance of directive principles under part-IV, and the responsibilities of the individuals towards society.
3	To understand the powers and functions of the Legislature, Executive, and judicial bodies.
4	To provide the information of FDs, Electoral Process, emergencies and amending procedures.

Unit	Description	Hrs
I	Introduction, Meaning and definitions. Salient features, Sources, Constituent Assembly, Drafting Committee. Preamble to the constitution of India.	**06**
II	Fundamental rights under part III – details of exercise of rights, Scopes & Limitations and, important cases	**06**
III	Relevance of directive principles of state policy under part-IV Fundamental duties and their significance-part-IV A	**04**
IV	Union Executive- President, Prime minister, Parliament and Supreme Court of India. State Executive – Governors, Chief Ministers, State legislature and High Courts.	**06**
V	Constitutional Special Provisions for Scheduled Castes and Tribes, Women, Children and backward classes. Emergency provisions under Part XVIII. Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, and 91stConstitutional amendments.	**06**

Course Outcomes:

COs	Descriptions
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.
CO2	Understand the freedom, rights and restrictions including directives, through fundamental duties.
CO3	Understand the importance of the three main organs of the constitution, Viz-the legislature, the executive and the judiciary.
CO4	Understand the power and functions of political institutions established throughout the country.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	1	3	3	2				
CO2						2	2	3	3	2				
CO3						2	3	3	2	2				
CO4						2	2	3	3	2				

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to the Constitution of India" (student edition)	DurgaDas Basu,	EEE, 19th/20th Edn.,2001
2	An Introduction to Constitution of India	MV Pylee.	Volume-1 Vikas Publishing, 2002

Reference Books:

Sl No	Reference book title	Author	Volume and Year of Edition
1	An Introduction to Constitution of India	Brij kishore Sharma,	Prentice-Hall of India, Volume-12002
2	Constitution of India and Professional Ethics	V. Rajaram	Second Edition New Age International Publication. 2011

Scheme of Teaching and Examination-2022 (160 Credits Scheme, NEP)

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

IV Semester B.E.

Sl No.	*Course Code*		*Course Title*	*Teaching Dept.*	*L*	*T*	*P*	*Credits*	*CIE*	*SEE*	*Total Marks*	*Exam Hrs*
01	BS	22SS401	Combinatorics and Advanced Linear Algebra	MA	3	-	0	3	50	50	100	3
02	PC	22IS402	Database Management System	IS	3	-	0	3	50	50	100	3
03	PC	22IS403	Object Oriented Programming	IS	3	-	2	4	50	50	100	3
04	PC	22IS404	Algorithm Design and Analysis	IS	3	-	2	4	50	50	100	3
05	PC	22IS405	Introduction to Automata Theory and Computation	IS	3	-	-	3	50	50	100	3
06	PC	22IS406	Dept. Skill Lab - II (Database Lab)	IS	1	-	2	2	50	50	100	3
07	HS	22HS407	Universal Human Values	HS	1	-	-	1	50	-	50	-
08	HS	22HS408	Environmental Studies	HS	1	-	-	1	50	-	50	-
L-Lecture, T-Tutorial, P-Practical,/Drawing, CIE-continuous Internal Evaluation, SEE-Semester End Examination				**Total**	**18**	**-**	**6**	**21**	**400**	**300**	**700**	**-**
Credits Distribution: Basic Science (BS)=08+08+3+3=22, Engineering Science (ES)=10+11=21, Humanities & Social Sciences (HS)=1+2+2=5, Program Core (PC)=02+16+16=34, Total Credits=20+20+21+21=82. Total 60 AICTE Activity points need to earn by each regular student and Total 35 AICTE Activity points need to earn by each Lateral entry student at the end of 2nd Year BE.												

Department: Mathematics			**Semester:**	**IV**
Subject: Combinatorics and Advanced Linear Algebra (Common to AI&ML, CR CS, DS and IS)				
Subject Code:	**22SS401**		**L – T – P - C:**	**3–0–0–3**

Sl. No	**Course Objectives**
1	To introduce the concept of generating function, exponential generating functions.
2	Describe the concepts of Derangements, Rook polynomials.
3	To solve simultaneous algebraic equations using methods of matrix algebra.
4	To introduce concepts of inner products to matrix decomposition.

Unit	**Description**	**Hrs**
I	**The principle of Inclusion and Exclusion:** The principle of Inclusion and Exclusion, Generalizations of Principle. Derangements, Rook Polynomials, Arrangements with forbidden positions.	**08**
II	**Generating functions:** Ordinary Generating functions**,** Definition and problems. Calculational Techniques, Partition of Integers, Exponential generating function, problems.	**07**
III	**Vector spaces**: Solution of system of equations by LU decomposition method. Vector space, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence (all statements only). **Basis and Dimensions:** Basis and Dimensions of Vector space and problems.	**09**
IV	**Linear transformation:** Introduction, Linear Mappings, Kernel and Image of a linear transformations, Matrix representation of linear transformations, Range space, Null space, Nullity, Rank-Nullity Theorem, Singular and Nonsingular linear transformations (all statements only), Problems.	**08**
V	**Inner Product spaces:** Inner product, norms of a vector, angle between vectors. Orthogonal vectors, orthogonal and orthonormal basis, projections of a vector. Gram-Schmidt orthogonalization process, QR-factorization (all statements only), problems. Diagonalization of a matrix (symmetric matrices) and singular value decomposition, Problems.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the concept Principle of inclusion-exclusion, Rook polynomial, generating function, vector space, linear transformations and Inner product spaces.
CO2	Apply the techniques of QR and singular value decomposition for data compression, LU factorization in solving linear system of equations.
CO3	Apply the knowledge of Rook polynomial, linear algebra to model and solve that appears in engineering sciences.
CO4	Apply the idea of generating functions, Linear transformations, Arrangement with forbidden positions and inner product spaces in Engineering field.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2	1	1										
CO3	3	3	1	1								1		
CO4	3	2	2											

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Discrete and Combinatorial Mathematics	Ralph P. Grimaldi	5th Edition, 2006, Pearson Education, ISBN-13: 978-81-7758-424-0.
2	Linear Algebra and its Applications	David C. Lay,	3rd Edition, 2002, Pearson Education India, ISBN-13: 978-81-7758-333-5.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Linear Algebra and its Applications	Gilbert Strang	4th Edition, 2006, Cengage Learning India Edition, ISBN: 81-315-0172-8.
2	Introductory Combinatorics	Richard A. Brualdi	5th Edition, 2014, Pearson Prentice Hall, ISBN:978-0136020400

Department: Information Science and Engineering			**Semester:**	**IV**
Subject: Database Management System				
Subject Code:	**22IS402**		**L – T – P - C:**	**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Knowledge of the architecture and functioning of Database Management Systems.
2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design.
3	Understand the use of Structured Query Language (SQL) and NoSQL.
4	Apply normalization techniques to normalize a database and understand the need of database transaction.

Unit	Description	Hrs
I	**Introduction:** Introduction with an example, Characteristics of Database approach, Actors on the scene, Workers behind the scene, Advantages of using DBMS approach, when not to use a DBMS. Data models, schemas and instances, Three schema architecture and data independence, Database languages and interfaces, The database system environment, Centralized and client-server architectures.	**08**
II	**Data Modeling using the Entity-Relationship (ER) Model:** Using High-Level Conceptual, Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relationship types of degree higher than two. Relational Database Design, Using ER- to-Relational Mapping. **Relational Model:** Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and dealing with constraint violations.	**08**
III	**SQL:** Data Definition and Data Types, Specifying constraints in SQL, Basic queries in SQL, Insert, Delete and Update statements in SQL, More complex SQL Queries, Views (Virtual Tables) in SQL, Schema change statements in SQL, **Database Stored Procedures and SQL/PSM:** Database Stored Procedures and Functions, SQL/PSM: Extending SQL for Specifying Persistent Stored Modules.	**08**
IV	**Database Design:** Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys. Introduction to transaction processing: Transaction and system concept, desirable properties of transactions. Characterizing Schedules Based on Serializability.	**08**
V	**Introduction to NoSQL(Not Only SQL):** Where is it used? , what is it?, Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL, What we miss with NoSQL?, use of NoSQL in industry, NoSQL vendors, SQL versus NoSQL, NewSQL Introduction, Comparision of SQL, NoSQL and NewSQL.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Explain the concepts of database management system.
CO2	Comprehend the different issues involved in the design and implementation of a database system
CO3	Illustrate various DBMS commands using SQL and NoSQL.
CO4	Apply normalization for Relational schema and Design a database for various applications using SQL and NoSQL.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1											1	2	
CO2	3	3	3	2							2	3	3	3
CO3	3	3	3	3	2		3	2				3	3	3
CO4	1			2			3					2	1	

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Fundamentals of Database Systems	Elmasri and Navathe	7thEdition, Pearson Education, 2017, ISBN-13: 978-9332582705.
2	Bigdata And Analytics	SeemaAcharya, Subhashini Chellappan, Infosys Limited	Publication: Wiley India Private Limited,1st Edition 2015. ISBN:978- 81-265-5478-2

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Database Management Systems	Raghu Ramakrishnan and Johannes Gehrke	3rd Edition, McGrawHill, 2014, ISBN-13:978- 9339213114.
2	An Introduction to Database Systems	C.J. Date, A. Kannan, S. Swamynatham	8th Edition, Pearson education, 2017, ISBN-13:978-817585568.

Department: Information Science and Engineering	**Semester:**	**IV**

Subject: Object Oriented Programming				
Subject Code:	**22IS403**		**L – T – P - C:**	**3 – 0 – 2 – 4**

Sl. No	Course Objectives
1	Understand the fundamentals of object-oriented programming.
2	Know the principles of inheritance, packages and interfaces.
3	Learn exception handling mechanism for reliable solutions.
4	Write Object oriented programs to solve real world problems.

Unit	Description	Hrs
I	**Introduction to Object oriented programming:** Fundamentals of Object Oriented Programming- Introduction, Object-Oriented Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, Applications of OOP. An Overview of Java -First Simple Java program: Entering the Program, Compiling the Program, A Closer Look at the First Sample Program, A Second short program, Java is a Strongly Typed Language. Introducing Classes: Class Fundamentals: The General Form of a Class, A Simple Class, Declaring Objects: A Closer Look at new, Assigning Object Reference Variables, Introducing Methods: Adding a Method to the Box Class, Returning a Value, Adding a Method That Takes Parameters, Constructors: Parameterized Constructors, The this Keyword: Instance Variable Hiding, Garbage Collection, A Stack Class.	**08**
II	**Classes and Methods:** A Closer Look at Methods and Classes: Overloading Methods: Overloading Constructors, Using Object as parameter, A Closer Look at Argument Passing, Returning Object, Introducing Access Control, Understanding Static, Introducing Final, Arrays Revisited, Introducing Nested and Inner Classes. Exploring the String Class, Using Command-Line Arguments.	**08**
III	**Inheritance:** Inheritance Basics: Member Access and Inheritance, A More Practical Example, A Superclass Variable Can Reference a Subclass Object, Using Super: Using super to Call Superclass Constructors, A Second Use for super, Creating Multi-Level Hierarchy, when Constructors are Executed, Method Overriding, Dynamic Method Dispatch: Why Overridden Methods?, Applying Method Overriding, Using Abstract Classes, Using Final with Inheritance: Using final to Prevent Overriding, Using final to Prevent Inheritance, The Object Class.	**08**
IV	**Packages and Interface:** Packages: Defining a Package, Finding Packages and CLASSPATH, A Short Package Example, Access protection: An Access Example, Importing Packages. **Interfaces:** Defining an Interface, Implementing Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces, Interfaces Can Be Extended, Default Interface Methods: Default Interface Methods, A More Practical Example, Multiple Inheritance Issues, Use Static Methods in an Interface.	**08**

V	**Exception Handling and Enumerations:** Exception Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch: Displaying a Description of an Exception, Multiple Catch Clauses, Nested try Statements, throw, throws, finally, Java's built-in Exceptions, Creating your own Exception Subclasses. Chained Exceptions. Three Recently Added Exception Features. **Enumerations:** Enumeration Fundamentals, The values() and valueOf() Methods ,Java Enumerations Are Class Types, Enumerations Inherit Enum, Another Enumeration Example.	**08**

LAB CONTENT

Sl. No	Experiment Description
1	Use Eclipse or Net bean platform and acquaint with the various menus. Create a test project, add a test class, and run it. See how you can use auto suggestions, auto fill. Try code formatter and code refactoring like renaming variables, methods, and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
2	Write a java program which reads your name and other details through command line and print them.
3	Write a Java Program that simulates the "wc" command of Unix Operating System. **Note:** The String of text should be Hardcoded in the program itself.
4	Write a Java program that implements Bubble sort algorithm for sorting in descending order and also shows the number of interchanges occurred for the given set of integers.
5	Write a Java program to search for an element in a given list of elements using binary search mechanism.
6	Write a Java program to find the area and volume of a room. Use a base class rectangle with a constructor and a method for finding the area. Use its subclass room with a constructor that gets the value of length and breadth from the base class and has a method to find the volume. Create an object of the class room and obtain the area and volume.
7	Design a class named Triangle to represent a triangle. The class contains: i. Three double instance variables named side1, side2 and side3 that specify the three sides of the triangle. The default values are 1 for all the sides. ii. A no-arg constructor that creates a default triangle. iii. A constructor that creates a triangle with the specified sides. iv. A get method to return the value of the instance variables. v. A set method to set a new value of the instance variables. vi. A method named getArea() that returns the area of this triangle. vii. A method named getPerimeter() that returns the perimeter. Write a test program that creates two Triangle objects. Assign sides 4, 5 and 6 to the first object and 1.5, 2.5 and 3.5 to the second object. Display the properties of both objects and find their areas and perimeters. (Hint: To find square root of a number use Math.sqrt function). **Note:** Modify the program so that inputs can also be read from Standard Input Device, the keyboard.

8	Design a class named Stock that contains: i. A string data field named symbol for the stocks symbol ii. A string data field named name for the stocks name. iii. A double data field named previousClosingPrice that stores the stock price for the previous day. iv. A double data field named CurrentPrice that stores the stock price for the current time. v. A constructor that creates a stock with specified symbol and name. vi. The accessor method for all data fields vii. The mutator method for previousClosingPrice and CurrentPrice. viii. A method named getchangePrecentage () that returns the percentage changed from previous closing price to current price. Write a test program that creates a stock object with the stock symbol SUNW, the name Sun Micro System Inc., and the previous price of 100 set a new current price to go and display the price- change percentage.
9	Write a Java Program to create an abstract class named shape that contains two integers and an empty method named printArea. Provide three classes named Rectangle, Triangle and Circle subclass that each one of the classes extends the Class Shape. Each one of the classes contains only the method printArea() that prints the area of Shape. **Note:** Read the input from the keyboard using Scanner Class.
10	Design a simple Java program to demonstrate different combinations of access control modifiers for: same package subclass, same package non-subclass, different package subclass, different package non-subclass. **Note:** Justify the result with the Access Protection table.
11	Consider the trunk calls of a telephone exchange. A trunk call can be ordinary, urgent or lightning. The charges depend on the duration and the type of the call. Write a program using the concept of polymorphism in Java to calculate the charges.
12	Write a program in Java to create a Player class. Inherit the classes Cricket _Player, Football _Player and Hockey_ Player from Player class.
13	The MyPoint class was created to model a point in a two- dimensional space. The MyPoint class has the properties x and y that represents x and y coordinates, two get methods for x and y and the method for returning the distance between two points. Create a class named ThreeDPoint to model a point in a three-dimensional space. Let ThreeDPoint be derived from MyPoint with the following additional features: i. A data field named z that represents the z-coordinate ii. A no-arg constructor that constructs a point with coordinates (0, 0, 0). iii. A constructor that constructs a point with three specified coordinates. iv. A get method that returns the z value. v. The distance method to return the distance between two points in the three-dimensional space. Implement the classes. Write a test program that creates two points (0, 0, 0) and (10, 30, 25.5) and display the distance between the two points.

14	Write a Java Program for the implementation of Multiple inheritance using interfaces to calculate the area of a rectangle and triangle.
15	Write a Java program which has: i. An interface for Stack Operations. ii. A class that implements the Stack Interface and creates a fixed length Stack. iii. A class that implements the Stack Interface and creates a dynamic length Stack. iv. A class that uses both the above Stacks through interface reference and does the stack operations that demonstrate the runtime binding.
16	Write a program to make a package Balance in which has Account class with Display_Balance method in it. Import Balance package in another program to access Display_Balance method of Account class.
17	On a single track two vehicles are running. As vehicles are going in same direction there is no problem. If the vehicles are running in different direction there is a chance of collision. To avoid collisions, write a Java program using exception handling. You are free to make necessary assumptions.
18	Write a Java program that demonstrates: i. Checked Exception ii. Unchecked Exception iii. Create your own exception subclasses
19	Write a java program to perform simple command line calculator with an exception handler that deals with nonnumeric operands; then write another program without using an exception handler to achieve the same objective. Your program should display a message that informs the user of the wrong operand type before exiting.
20	Write a JAVA program to create an enumeration Day of Week with seven values SUNDAY through SATURDAY. Add a method isWorkday( ) to the DayofWeek class that returns true if the value on which it is called is MONDAY through FRIDAY.

Note: Apart from the above mentioned Question Bank, students are also expected to-do programs that are discussed in Theory class.

Course Outcomes:

Course outcome	Descriptions
CO1	Describe the fundamentals of Object-Oriented Programming.
CO2	Identify classes, objects, members of a class and relationships among them needed for a specified problem.
CO3	Design and implement object oriented solutions involving multiple objects, packages and Interfaces.
CO4	Develop reliable programs by using exception handling mechanism.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2		3							3		
CO2	2	2	3	2	3		2	2	1			3		
CO3	2	3	3	2	3			2	1			3		
CO4	2	3	3	3	3		2	2	1			3		

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Java - The Complete Reference	Herbert Schildt	12th Edition, Tata McGraw Hill, 2022, ISBN: 978-1-26-046342-2
2	Programming With Java	E Balagurusamy	6th Edition, Tata McGraw Hill, 2019, ISBN: 978-93-5316-234-4

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to JAVA Programming, Comprehensive Version 10e	Y. Daniel Liang	10th Edition, Pearson Education, 2018, ISBN-13:978-9353065782

Department: Information Science and Engineering	**Semester:**	**IV**

Subject: Algorithm Design and Analysis				
Subject Code:	**22IS404**		**L – T – P – C:**	**3 – 0 – 2 – 4**

Sl. No	Course Objectives
1	Understand basic efficiency classes and asymptotic notations to express the complexity of algorithms.
2	Know the different Algorithm Design Techniques for effective problem solving.
3	Analyze the algorithm with respect to space and time complexity.
4	Comparison of algorithm efficiency in different design techniques.

Unit	Description	Hrs
I	**Introduction, Fundamentals of the Analysis of Algorithm Efficiency, Brute Force:** Algorithm Definition, Fundamentals of algorithmic problem solving, Analysis Framework, Formal Definitions of Asymptotic Notations, Basic efficiency classes, Mathematical analysis of Non-Recursive and recursive Algorithms with Examples. Brute Force: String Matching.	**08**
II	**Divide and Conquer:** Merge Sort, Quick Sort, Finding the Maximum and Minimum. Decrease and Conquer: Insertion Sort, Topological Sorting.	**08**
III	**Transform and Conquer:** Heaps and Heap Sort and AVL Trees. **Space and Time Tradeoffs:** Input Enhancement in String Matching- Horspool's algorithm, Hashing: Hash table, Hash functions, Collision handling by open addressing and chaining.	**08**
IV	**Greedy Technique:** Prim's algorithm, Kruskal's algorithm, Dijkstra's algorithm. **Dynamic Programming:** Floyd's Algorithms, Knapsack Problem and Memory Functions.	**08**
V	**Back tracking:** n-Queen's Problem, Subset-Sum Problem. **Branch and Bound:** Assignment Problem, Knapsack Problem, and Traveling Salesman Problem.	**08**

LAB CONTENT

Sl. No	Experiment Description
1	**Brute Force:** String matching.
2	**Divide and Conquer:** • Sort a given set of elements using Merge sort. • Sort a given set of elements using Quick Sort. • Finding the Maximum and Minimum element in an array of • 'n' integers.
3	**Decrease and Conquer:** • Print the vertices of the directed acyclic graph in topological order using Source Removal Method. • Sort a given set of elements using Insertion Sort.
4	**Transform and Conquer:** • Create a heap tree for a given list of N elements using Bottom-up approach and sort the elements using Heap Sort technique.
5	**Space and Time Tradeoffs:** • Implement Horspool algorithm for String Matching.
6	**Greedy Technique:** • Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm. • Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm. • From a given vertex in a weighted connected graph, find the shortest paths to other vertices using Dijkstra's algorithm.
7	**Dynamic Programming:** • Solve Knapsack problem and print the solution vector. • Find all pair shortest path using Floyd's Algorithm.
8	**Back Tracking:** • Implement N Queen's algorithm. • Find a subset of a given set S of N positive integers whose sum is equal to a given positive integer D.

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the basic concepts of algorithm analysis.
CO2	Demonstrate various algorithm design techniques.
CO3	Design an algorithm and analyze its complexity to rank order of growth.
CO4	Apply the appropriate algorithm design technique to solve the given problem instance.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2											
CO2	1	3	3	2										
CO3		2	2	2								1		
CO4	2	3	3	2										

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to the Design & Analysis of Algorithms	Anany Levitin	3rd Edition, Pearson Education, 2012, ISBN-13: 978-0-13-231681-1
2	Computer Algorithms/C++	Ellis Horowitz, Satraj Sahni and Rajasekaran	2nd Edition, 2019, Universities Press, ISBN-13: 978-8173716119

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Algorithms	Cormen T.H, Leiserson C.E.&Rivest R.L	3rdEdition, PHI, 2012, ISBN- 13: 978-0262033848
2	Algorithm Design Pearson,	Jon Kleinberg and Eva Tardos,	1st Edition, 2013.
3	Design and Analysis of Algorithms	S. Sridhar	Oxford university press, 2014.

Department: Information Science and Engineering			Semester:	IV
Subject: Introduction to Automata Theory and Computation				
Subject Code:	22IS405		L – T – P - C:	3 – 0 – 0 – 3

Sl. No	Course Objectives
1	Understand core concepts in Automata and Theory of Computation.
2	Know different Formal Language Classes and their Relationships.
3	Prove or disprove theorems in Automata Theory.
4	Compare finite automata, Push Down Automata and Turing Machines as Mathematical models of computation.

Unit	Description	Hrs
I	**Finite Automata:** Definition of Deterministic Finite Automata, How a DFA processes strings, Simpler notations for DFA's, Extending the transition function to strings, The language of a DFA, Nondeterministic Finite Automata (NFA): Definition of NFA, An Extended Transition Function, The language of NFA, Equivalence of DFA and NFA, Finite Automata with Epsilon-transitions. An Application: Text Search.	**08**
II	**Regular Expressions and Languages:** Regular Expression, Converting DFA's to Regular Expressions by eliminating states, Converting Regular Expressions to Automata, Applications of Regular Expressions. **Properties of Regular Languages:** Equivalence and Minimization of Automata: Testing Equivalence of states, Testing Equivalence of Regular Languages, Minimization of DFA's.	**08**
III	**Context-Free Grammars and Languages:** Definition of Context-Free Grammars, Derivations using a Grammar, Leftmost and Rightmost Derivations, The language of a grammar, Sentential forms, Parse Trees: Constructing Parse Trees, The yield of a Parse tree, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages: Ambiguous grammars, Removing Ambiguity from grammars, Leftmost derivations as a Way to Express Ambiguity, Inherent Ambiguity.	**08**
IV	**Properties of Context-Free Languages:** Normal Forms for CFGs, Eliminating Useless Symbols, Eliminating ϵ- Productions, Eliminating Unit Productions, Chomsky Normal Form. **Pushdown Automata:** Formal Definition, A Graphical Notation for PDA's, Instantaneous Descriptions of a PDA, The Languages of a PDA: Acceptance by Empty Stack and Final State, Definition of a Deterministic PDA.	**08**
V	**Introduction to Turing Machines:** The Turing Machine: Notation for the Turing Machine, Instantaneous Descriptions for Turing Machines, Transition Diagrams for Turing Machines, The Language of a Turing Machine, Turing machines and Halting. Turing Machines and Computers.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Explain the concepts of automata theory and its applications.
CO2	Design computational models to accept a given language and vice versa.
CO3	Demonstrate the equivalence among different automata models.
CO4	Design and simulate automata models to accept a given language.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	3	3	3										
CO3	3	3	3	3										
CO4	2	2	2	2	3									

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Automata Theory, Languages and Computation	John E Hopcroft, Rajeev Motwani, Jeffery D Ullman	3rd Edition, Pearson Education Limited 2014 ISBN 13:978-1-292-03905-3

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Introduction to Languages and Theory of Computation	John C Martin	3rd Edition, Tata McGraw –Hill Education, 2013 ISBN. 978-0-07-066048-9.
2	An Introduction to Formal Languages and Automata	Peter Linz	6th Edition, Narosa Publishing House, 2016 ISBN: 9781284077254

Department: Information Science and Engineering	**Semester:**	**IV**

Subject: Data Base Lab				
Subject Code:	**22IS406**		**L – T – P - C:**	**1 – 0 – 2 – 2**

Sl. No	Course Objectives
1	Understand how a real world problem can be mapped to schemas.
2	Solve different industry level problems & to learn its applications.
3	Emphasize the importance of normalization in databases.
4	Solve different industry level problems & to learn its applications.

LAB CONTENT

Sl. No	Experiment Description
Cycle 1	**Consider the following schema for Insurance database:** PERSON (driver_id , name, address) CAR (regno, model, year) ACCIDENT (reportno, accd_date, location) OWNS (driver_id, regno) PARTICIPATED (driver_id, regno, reportno, damage_amt)
Cycle 2	**Consider the following database schema for student database:** STUDENT (usn, name, major, bdate) COURSE (courseno, cname, dept) TEXT (book_ISBN, book_title, publisher, author) ENROLL (usn,courseno, sem, marks) BOOK _ ADOPTION (courseno, sem, book_ISBN)
Cycle 3	**Consider the schema for Company Database:** DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate) EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DLOCATION (DNo,DLoc) PROJECT (PNo, PName, PLocation, DNo) WORKS_ON (SSN,PNo, Hours)
Cycle 4	**Consider the following schema for Movie Database:** ACTOR (Act_id, Act_Name, Act_Gender) DIRECTOR (Dir_id, Dir_Name, Dir_Phone) MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST (Act_id,Mov_id, Role) RATING (Mov_id, Rev_Stars)

Cycle 5	**Mini-Project:** A Mini Project should be implemented and shall be carried out in a batch of two students. The students will finalize a topic in consultation with the faculty. The mini project must be carried out in the college only. The Mini Project tasks would involve: a. Understand the complete domain knowledge of application and derive the complete data requirement specification of the Mini Project b. Design of the project c. Normalization of the Relational design. d. Documentation and submission of report. **Typical Mini Projects:** a. Placement management system. b. Result management & analysis system. c. SSIT Blog management system. d. Student Feedback system. e. Library management. f. Electricity Bill Management System. g. Online Retail Application Database. h. Inventory Control Management. i. Library Management System. j. Student Database Management. k. Payroll Management System. l. Voice-based Transport Enquiry System. m. SMS-based Remote Server Monitoring System. n. Restaurant Management. o. Pharmacy Management System. p. Hospital Management System. q. Centralized College Database. r. Art Gallery Management Database.

Instructions:

Using given schema:

1. Draw an Entity-Relationship (ER) Model.
2. Implement SQL Queries using DDL and DML Statements.
3. Implement SQL Nested queries and Views.

Course Outcomes:

Course outcome	Descriptions
CO1	Design database schema for a given problem and enforce different constraints on a database using RDBMS.
CO2	Populate and query a database using SQL and NoSQL.
CO3	Develop database applications with interactive user interface.
CO4	Able to write report for the project developed.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3						1			3		
CO2	2	3	3	2	3							3		
CO3	2	2	3						2			3		
CO4	2	3							3	3		3		

Department: Humanity Science			Semester:	IV
Subject: Universal Human Values				
Subject Code:	22HS407		L – T – P - C:	1-0-0-1

Sl. No	Course Objectives
1	This introductory course input is intended: To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings
2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.
4	This course is intended to provide a much needed orientation input in value education to the young enquiring minds.

Unit	Description	Hrs
I	**Introduction to Value Education:** -Understanding Value education-Need, Guidelines, content, Role of education-Sanskar -Process for Value Education-Self-exploration, the Dialogue Within. -Continuous Happiness and Prosperity – the Basic Human Aspirations. -Right Understanding, Relationship and Physical Facility. -Exploring the Meaning of Happiness and Prosperity. -Method to Fulfill the Basic Human Aspirations	**06**
II	**Harmony in the Human Being:**-Understanding the Human being (As the Co-existence of the Self and Body) -Distinguishing between the Needs of the Self and the Body -The Body as an Instrument of the Self-The response of the self and the body -Understanding Harmony in the Self-State of imagination -Understanding Harmony of the Self with the Body -Programme to ensure self-regulation and Health-Nurturing the body	**06**
III	**Understanding Harmony in the Family and Society** Harmony in the Family – the Basic Unit of Human Interaction Values in Human-to-Human Relationship “Trust' – the Foundational Value in Relationship 'Respect' – as the Right Evaluation.- Other Naturally Acceptable Feelings in Relationship-Affection, Care, Guidance, Reverence, Glory, Gratitude and Love Vision for the Universal Human Order-from family to world family.	**06**
IV	**Understanding Harmony in the Nature/Existence:** -Understanding Harmony in the Nature	**04**

	-Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature -Realizing Existence as Co-existence at All Levels- The Holistic Perception of Harmony in Existence	
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values -Definitiveness of (Ethical) Human Conduct -A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order -Competence in Professional Ethics -Holistic Technologies, Production Systems and Management Models- Typical Case Studies -Strategies for Transition towards Value-based Life and Profession	**06**

Course Outcomes:

COs	Descriptions
CO1	By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO2	They would have better critical ability, also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO3	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
CO4	This is only an introductory foundational input. It would be desirable to follow it up by a) Faculty-student or mentor-mentee programs throughout their time with the institution b) Higher level courses on human values in every aspect of living

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				1		3	3	3	2	3				
CO2				2		3	3	3	2	3				
CO3				2		3	3	3	2	3				
CO4				2		3	3	3	2	3				

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Sangal G P Bagaria,	Excel Books, New Delhi,2010
2	The Teacher's Manual Teachers' Manual for A Foundation Course in Human Values and, Professional Ethics	R R Gaur, R Asthana, G P Bagaria	2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Jeevan Vidya: EkParichaya,.	A Nagaraj,	Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values,	A.N. Tripathi,	New Age Intl. Publishers, New Delhi, 2004
3	The Story of Stuff (Book). . i)Small is Beautiful ii)Slow is Beautiful	E. F Schumacher. Cecile Andrews	
4	The Story of My Experiments with Truth	Mohandas Karamchand Gandhi	

Department: Humanity Science			**Semester:**	**IV**
Subject: Environmental Studies				
Subject Code:	**22HS408**		**L – T – P - C:**	**1-0-0-1**

Sl. No	Course Objectives
1	To identify the major challenges in environmental issues and evaluate possible solutions. To analyze an overall impact of specific issues and develop environmental management plan.
2	Develop analytical skills, critical thinking and demonstrate socio-economic skills for sustainable development.
3	To gain knowledge on different types of pollution in the environment.
4	To analyze an overall impact of specific issues and develop environmental management plan. Environment.

Unit	Description	Hrs
I	Introduction: Environment - Components of Environment Ecosystem: Types of Ecosystem, Balanced ecosystem. Human Activities – Food, Shelter, And Economic & Social Security, Effects of human activities on environment-Agriculture, Housing, Industry, Mining & Transportation. Environmental Impact Assessment (EIA), Sustainable Development.	**06**
II	Natural Resources-Introduction, types of resources, Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water. Mineral resources**,** Forest Wealth. Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle.	**06**
III	Energy – Different types of energy, Conventional sources & Non-conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	**06**
IV	Environmental Pollution – Air Pollution & Automobile Pollution Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. Global Environmental Issues: Population Growth, Urbanization, Land Management, Water & Waste Water Management.	**04**
V	Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. Solid Waste Management, E - Waste Management & Biomedical Waste Management -Sources, Characteristics & Disposal methods. Environmental Acts & Regulations, Role of government, Legal aspects, Role of Non-governmental Organizations (NGOs) , Environmental Education	**06**

Course Outcomes:

COs	Descriptions
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	3	3	2	2	2	1	3		
CO2	2	2	1	1	1	3	3	2	2	2	1	1		
CO3	2	2	1	1	1	3	3	2	2	2	1	1		
CO4	2	2	1	1	1	3	3	2	2	2	1	1		

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Environmental Studies	Benny Joseph	Tata McGraw– Hill Publishing Company Limited (2005), Delhi.
2	Environmental Studies	R Rajagopalan	From Crisis to Cure", Oxford University Press, 2005

Reference Books:

Sl No	Reference book title	Author	Volume and Year of Edition
1	Environmental Science and Engineering	Aloka Debi,	Universities Press (India) Pvt. Ltd. 2012
2	Environmental Studies	R.J.Ranjit Daniels	Wiley India Private Ltd., New
3	Text Book of Environmental and Ecology",	Dr.Pratiba Sing, Dr.AnoopSingh and Dr.Piyush Malaviya,	Acme Learning Pvt. Ltd. New Delhi
4	Environmental Science – working with the Earth	G.Tyler Miller Jr.,	Eleventh Edition, Thomson Brooks /Cole, 2006