

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belgaum)



Autonomous Programme
Bachelor of Engineering

DEPARTMENT OF
Computer Science and Business Systems

SYLLABUS

III & IV Semester (2022 Admitted Batch)

(2nd Year)

Academic Year 2023-24

VISION

Emerge as an industry focused centre for promoting innovation, entrepreneurship, research and best practices of computer science together with managerial skills to serve the society and industry.

MISSION

1. Impart globally connected cutting-edge technologies and business skills
2. Enhance industrial experience, promote entrepreneurship and research through industry institute interaction
3. Implement best practices to enrich knowledge and skill sets
4. Produce competent professionals with societal and environmental concern

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Explore and excel in emerging domains of computer science and business system

PEO2: Acquire leadership qualities, capacity to work in diverse teams and be an effective business communicator

PEO3: Develop professional skills that equip employability and higher education in the contemporary areas of Computer Science and Business Systems

PEO4: Empower Research Skills by designing and developing solutions in the field of IT and facilitate to take up higher studies

PEO5: Impart industry ready business skills through collaborations to bridge the gap between

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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)

Upon graduation, students with a degree B.E. in Computer Science and Business System Program will be able to:

1. Develop efficient computer based systems to solve real life problems.
2. Apply the concepts of Enterprise Resource Planning, Quality, Financial, Supply and Logistic Management in Engineering and Technology.
3. Implement tools and technologies of industry 4.0 to design and develop industry relevant projects.

INTRODUCTION

To address the growing need of engineering talent with skills in digital technology, TCS, in partnership with leading academicians across India, has designed a curriculum for 4 years undergraduate program on Computer Science titled "Computer Science and Business Systems (CSBS)." This curriculum aims to ensure that the students graduating from the program not only know the core topics of Computer Science but also develop an equal appreciation of humanities, management sciences and human values.

The students are also exposed to emerging topics such as Analytics, Machine Learning, Cloud Computing, Internet of Things etc. to make them industry ready at the end of four years of study.

The course focuses on enhancing the following key attributes among graduating students:

- Understanding of Contemporary Technology
- Understanding of Technology Abstraction
- Knowledge of Common Business Principles
- Business Discipline and Service Orientation
- Innovation Ability
- Strong in Ethics and Life Values

The Bachelor of Engineering degree program in Computer Science and Business Systems will provide the technical background and understanding to apply IT solutions in a business context, and use them to develop opportunities for growth.

The Computer Science and Business Systems degree aims to produce professionals with the capabilities to face the most up to date organizational and information systems' and technological challenges.

In the recent years, new computing platforms and paradigms have emerged, such as the growing number of mobile devices (smart phones and tablets) and cloud computing and virtualization that created new organizational challenges. On the other side, the social networks growth and the collection and analysis of huge volumes of data (Big Data) also represent additional challenges for modern organizations.

Throughout their path across the Computer Science and Business System degree, students will learn curricular units about operating systems, computer architecture, programming, information systems and networks in a perfect coexistence with subjects such as general management, marketing, finance and accounting

The integration between such curricular units help to shape the Computer Science and Business System graduates' profile, creating an important differentiation from others, contributing to its success and reflecting on high employability rates

Scheme of Evaluation (Theory Courses)

Assessment	Marks
Three CIE's conducted for 20 marks each and reduced to 10 – Total of 30 marks	30
Activities as decided by course faculty	20
SEE	50
Total	100

Scheme of Evaluation (Lab Integrated Courses)

Assessment	Marks
Three CIE's conducted for 20 marks each and reduced to 10 – Total of 30 marks	30
Activities – 20 Marks 1. Continues Evaluation in every lab session by the course faculty – 5 Marks 2. Record Writing – 5 Marks 3. Lab CIE (Conducted for 50 marks and reduced to 10 marks) – 10 Marks	20
SEE	50
Total	100

Scheme of Evaluation (Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the course coordinator	10
Record writing	20
Laboratory CIE conducted by the course coordinator	20
SEE	50
Total	100

Examination	Maximum Marks	Minimum marks to qualify
CIE	50	20 (12 in CIE + 8 in activity)
SEE	50 (Conducted for 100 and reduced to 50)	20

Scheme & Syllabus for II Year

B. E. Computer Science and Business System

Academic Year 2023-24

Third Semester					
Course Category	Course Code	Course Title	L-T-P in hours	Credit	Contact Hours
BSC	22CB301	Computational Statistics	2-2-0	3	4
PCC	22CB302	Digital Design and Computer Organization	2-2-0	3	4
PCC	22CB303	Operating System	3-0-0	3	3
IPCC	22CB304	Data Structures	3-0-2	4	5
PCC	22CB305	Fundamentals of Management	3-0-0	3	3
PCCL	22CBL306	Unix and Shell Programming Lab	0-0-2	1	2
ESC	22CB307x	ESC/ETC/PLC	2-2-0	3	4
UHV	22CB308	Social Connect and Responsibility	0-0-2	1	2
AEC/SEC	22CB358x	Ability Enhancement Course/ Skill Enhancement Course-III	0-0-2	1	2
Total				22	29

Engineering Science Course (ESC/ETC/PLC)			
22CB307A	OOP with Java	22CB307C	Quantum Computing
22CB307B	Python for Data Science	22CB307D	Human Resource Management
Ability Enhancement Course – III			
22CB358A	Data Analytics with Excel	22CB358C	Data Visualization using Tableau and Power BI
22CB358B	R Programming	22CB358D	Business Communication

Scheme & Syllabus for II Year

B. E. Computer Science and Business System

Academic Year 2023-24

Fourth Semester					
Course Category	Course Code	Course Title	L-T-P in hours	Credit	Contact Hours
BSC	22CB401	Linear Algebra	2-2-0	3	4
PCC	22CB402	Theoretical Foundations Of Computation	2-2-0	3	4
IPCC	22CB403	Design and Analysis of Algorithms	3-0-2	4	5
PCC	22CB404	Entrepreneurship and Business Development	3-0-0	3	3
PCC	22CB405	Database Management Systems	3-0-0	3	3
PCCL	22CB406	Web Application Development Laboratory	0-0-2	1	2
ESC	22CB407x	ESC/ETC/PLC	2-2-0	3	4
UHV	22UHK408	Universal Human Values	0-0-2	1	2
BSC	22BOK409	Biology For Engineers	0-0-2	1	2
AEC/SEC	22CB458x	Ability Enhancement Course/Skill Enhancement Course-III	0-0-2	1	2
Total				23	31

Engineering Science Course (ESC/ETC/PLC)			
22CB407A	Object Oriented Programming	22CB407C	Quantum Computing
22CB407B	Python for Data Science	22CB407D	Human Resource Management
Ability Enhancement Course – IV			
22CB458A	Data Analytics with Excel	22CB458C	Data Visualization using Tableau and Power BI
22CB458B	R Programming	22CB458D	Business Communication

Course Title	COMPUTATIONAL STATISTICS		
Course Code	22CB301	L-T-P-C	(2-2-0)3
Exam Hrs.	3 Hours	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: To equip students with a solid foundation in computational statistics, enabling them to analyze and interpret data, make informed decisions based on statistical evidence, and effectively communicate statistical findings.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate the fundamental statistical concepts, descriptive statistics, probability theory, hypothesis testing, regression techniques	1	-
2.	Apply a range of statistical techniques including hypothesis testing, regression analysis, analysis of variance, and categorical data analysis to solve problems	1, 5	1
3.	Analyze the given real-world datasets using the appropriate statistical methods	2,5	1
4.	Interpret statistical output, draw meaningful conclusions, and effectively communicate the results of their analyses	3, 5, 9, 10	-
Course Contents:			
Module 1			10 Hours
Introduction to Statistical Concepts			
Introduction to Statistics, Definition and importance of statistics, Types of data and variables, Descriptive Statistics, Measures of central tendency (mean, median, mode), Measures of variability (range, variance, standard deviation), Data visualization techniques (histograms, box plots).			
Probability Basics, Probability theory and terminology, Probability rules and laws, Probability distributions (discrete and continuous), Sampling and Estimation, Sampling methods and techniques, Point estimation and confidence intervals, Sample size determination.			
Module 2			10 Hours
Statistical Inference			
Hypothesis Testing, Introduction to hypothesis testing, Null and alternative hypotheses, Type I and Type II errors, significance level, and p-values, Parametric Tests, One-sample and two-sample t-tests, Analysis of variance (ANOVA), Chi-square test for independence. Non-parametric Tests.			
Statistical Models and Analysis			
Introduction to Regression Analysis, Simple linear regression, Assumptions and interpretation Coefficient of determination (R-squared), Multiple Regression Analysis, Multiple linear regression,			
Module 3			10 Hours
Statistical Models and Analysis			
Model assumptions and diagnostics, Variable selection techniques (stepwise, backward, forward), Analysis of Categorical Data.			
Logistic regression, Odds ratio and interpretation, Goodness-of-fit tests (chi-square, Hosmer-Lemeshow), Analysis of Variance (ANOVA)			
One-way and two-way ANOVA, Post hoc tests (Tukey's HSD, Bonferroni), Introduction to Experimental Design.			
Module 4			10 Hours
Introduction to Statistical Software			
Overview of popular statistical software, Exploratory Data Analysis, Data visualization techniques (scatter plots, bar charts), Data cleaning and preprocessing, Statistical Analysis with Software, Conducting descriptive statistics and hypothesis tests, Implementing regression			

analysis and ANOVA, Interpreting output and generating reports, Practical Data Analysis Project, Applying statistical concepts and techniques to a real-world dataset, Exploratory analysis, hypothesis testing, and model building.

Text Books:

1. Fundamentals of Statistics S C Gupta, Himalaya Publishing House (7th Edition), ISBN-10:9350517698
2. Statistics for Business: Decision Making and Analysis (2nd Edition), Robert Stine, Pearson ISBN: 9780136759102, 2017.

Reference Books:

1. "Introduction to Statistical Learning with Applications in R" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani.
2. "Statistical Computing with R" by Maria L. Rizzo. 2nd edition, Chapman and Hall/CRC, Taylor and Francis Group, 2019.
3. "Bayesian Data Analysis" by Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and Donald B. Rubin.
4. "Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery.

MOOCs:

1. https://onlinecourses.swayam2.ac.in/cec21_ma04/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2	✓				✓								✓	
CO3		✓			✓								✓	
CO4			✓		✓				✓	✓				

Course Title		DIGITAL DESIGN AND COMPUTER ORGANIZATION	
Course Code	22CB302	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50 (30-20-0)
Course Objective: To understand the basic circuit design and structure of a computer Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge of Boolean algebra and digital logic to simplify logical expressions. Comprehend the basic structure and working principles of computers	1	1
2.	Analyze and solve problems related to digital circuits and computer organization using appropriate techniques and tools.	2	1
3.	Design and implement digital circuits to solve complex logic expressions and contribute to the basic structure of computer systems	3	1
4.	Work collaboratively and demonstrate the components and operation of digital design concepts and computer organization principles through clear documentation and presentation	5, 8,9,10,12	-
Course Contents:			
Module 1			10 Hours
Number Systems and Codes: Binary Number system, Binary to decimal, decimal to binary, hexa decimal, ASCII code, Excess,3 Code, Gray code. Digital Logic: The Basic Gates, NOT, OR, AND, Universal Logic Gates, NOR, NAND. Combinatorial Logic Circuits: Boolean Laws and Theorems, Sum of Products method, Truth table to Karnaugh Map – Pairs, Quads, Octets – Don't Care Conditions Product of sums method, Product of sums Simplifications Combinational Circuits – Karnaugh Map, Analysis and Design Procedures, Binary Adder, Subtract or, Decimal Adder, Magnitude Comparator, Decoder, Encoder, Multiplexers, Demultiplexers			
Module 2			10 Hours
Data Processing Circuits: Multiplexers, Demultiplexers, 1of,16 Decoder, BDC to decimal Decoders, Seven segment Decoders, Encoders, Exclusive OR Gates, Parity Generators and Checkers. Arithmetic Circuits: Binary Addition, Binary Subtraction, 2'S Complement Representation, 2'S Complement Arithmetic, Arithmetic Building Blocks. Introduction to Sequential Circuits – Flip Flops, operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits, Design, Moore/Mealy models, state minimization, state assignment, circuit implementation, Registers, Counters.			
Module 3			10 Hours
Basic Structure of Computers: Basic Operational Concepts, Numbers, Arithmetic Operations and Characters. Memory Location and Addresses. Input/Output Organization: Accessing I/O Devices, Interrupts, Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Standard I/O Interfaces – PCI Bus, USB.			
Module 4			10 Hours
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories Mapping Functions. Arithmetic: Signed Operand Multiplication, Fast multiplication, Integer Division, Floating-point Numbers and Operations , IEEE standard for floating point numbers. Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard,wired Control.			
Text Books:			

1. Digital Principles and Applications – Donald P Leach, Albert Paul Malvino, GoutamSaha, 8thedition ,McGrawHill Education, 3rd reprint 2015.
2. Computer Organization - Carl Hamacher, Zvonko Vranesic, SafwatZaky, 5th Edition, Tata McGraw Hill.

Reference Books:

1. Digital design, R.AnanthaNatarajan, PHI Learning, 2015.
2. Computer Organization and Architecture, V.Rajaraman and T.Radhakrishnan, PHI learning, 5th Print, 2015.

MOOCs:

1. <https://nptel.ac.in/courses/117105080/>
2. Switching circuits and logic design <https://nptel.ac.in/courses/106/105/106105185/>
3. Digital Circuits and Systems SWAYAM IIT-Madras,https://swayam.gov.in/ndl_noc19_ee51

Activity: Students must conduct the following activities

Simulation using LTspice/Multisim

1. Arithmetic Circuits
2. Logic Circuits
3. Combinational circuits
4. Data Processing circuits
5. Sequential Circuits

Conduct the below experiments

1. know the components of a Computer and its peripherals
2. Assemble and disassemble the computer
3. Formatting a partitioning of HDD
4. Configuring a bootable device
5. Installation of Operating System, Virtual Machines and Network and Internet configuration

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓												✓	
CO2		✓											✓	
CO3			✓										✓	
CO4					✓			✓	✓	✓		✓		

Course Title		OPERATING SYSTEMS	
Course Code	22CB303	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will be able to understand the working of operating system.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Comprehend the fundamentals of operating systems components, functions, and their interactions within computer systems	-	-
2.	Apply the process scheduling, disk Scheduling and memory management algorithms for processes, disk and memory management	1	-
3.	Analyze the given scenario and identify the appropriate algorithm and solve the problems	2	1
4.	Design solutions for process synchronization and deadlock prevention using synchronization techniques and apply concepts of memory management strategies in various scenarios	3	1
Course Contents:			
Module 1			10 Hours
Introduction to Operating Systems, System Structures: What Operating Systems Do? Computer System Architecture; Operating System Structure; Operating System Operations; Operating System Services; System Calls; Types of System Calls; System Programs, Process Management: Process Concept; Operations on Processes; Inter-Process Communication. Multi-Threaded Programming: Overview; Multithreading Models.			
Module 2			10 Hours
Process Management (contd.): Process Scheduling: Basic Concepts; Scheduling Criteria; Scheduling Algorithms; Process Synchronization: The Critical Section Problem; Peterson's Solution; Synchronization Hardware; Semaphores; Classic problems of Synchronization, Monitors- Usage, Dining-Philosophers solution using monitors.			
Module 3			10 Hours
Deadlocks: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from Deadlock. Memory Management: Memory Management Strategies: Background; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation.			
Module 4			10 Hours
Virtual Memory Management: Background; Demand Paging; Page Replacement. Storage Management: Secondary Storage Structures, Protection: Mass Storage Structures; Disk Structure; Disk Scheduling; Swap Space Management. Protection: Goals of Protection, Principles of Protection, Domain of Protection- Domain Structure, Access Matrix, Implementation of Access Matrix.			
Text Books:			
1. Operating System Concepts - Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 9th Edition, 2018, John Wiley & Sons, ISBN 978-1-265-5427-0			
Reference Books:			
1. Modern Operating Systems - A Concept Based Approach -Andrew.S.Tanenbaum, 4th Edition, Addison Wesley, 2015. ISBN: 978-0133591620.			
2. Introduction to Operating Systems: Concepts and Practice - P.C.P. Bhatt, 2nd Edition, PHI, 2008.			
3. Operating Systems Internals and Design Principles, William Stallings: 8th Edition, Tata McGraw-Hill Education , 2007, ISBN - 978-0070611948.			
MOOCs:			
1. Fundamentals of Operating System https://nptel.ac.in/courses/106/105/106105214/			
Activity			

Course Title	Data Structures		
Course Code	22CB304	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	50
Course Objective: Students will be able to use appropriate data structures for solving problems.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply principles of Data Structures for solving problems	1	-
2.	Analyze and develop operations on linear and non-linear data structures	2	-
3.	Design and develop solutions using the operations of linear and nonlinear data structure for a given problem.	3	1
4.	Conduct practical experiments for demonstrating the operations of different data structures.	3, 5, 9,10	-
Course Contents:			
Module 1			10 Hours
Introduction to Data Structures: Definition, Classification of Data Structures, Dynamic Memory Allocation – Introduction, Dynamic memory allocation, malloc, calloc, free and realloc. The Stack - Definition and examples: Primitive operations, Example. Representing stacks in C: Implementing the pop operation, testing for exceptional conditions, implementing the push operation.			
Infix, postfix and prefix: Basic definitions and examples, evaluating a postfix expression, Program to evaluate a postfix expression, converting an expression from infix to postfix, Program to convert an expression from infix to postfix.			
Module 2			10 Hours
Recursion: Recursive definition and processes: Factorial function, Multiplication of natural numbers, Fibonacci sequence, Binary search, Properties of recursive definition or algorithm.			
Recursion in C: Factorial of a number, generation of Fibonacci numbers, Binary searching, Concept of Recursive chains, Towers of Hanoi problem,			
Queues and lists: The queue and its sequential representation: C implementation of queues, Insert operation, Priority queue, Array implementation of a priority queue.			
Linked lists: Inserting and removing nodes from a list, Linked implementation of stacks. Getnode and freenode operations.			
Module 3			10 Hours
Lists in C: Array implementation of lists, Limitations of array implementation, allocating and freeing dynamic variables, linked lists using dynamic variable, Queues as lists in C, Examples of list operations in C, Non integer and non-homogeneous lists.			
Other list structures: Circular lists, Stack as a circular list, Queue as a circular list.			
Module 4			10 Hours
Trees -Binary trees: Operations on binary trees, Applications of binary trees. Binary tree representation: Node representation of binary tree, Internal and external node, Implicit array representation of binary trees, choosing a binary tree representation, Binary tree traversals in C, Threaded binary trees.			
Text Books:			
1. Data structures using C and C++, YedidyahLangsam and Moshe J. Augenstein and Aaron M.Tenanbaum, PHI, 2008 Chapters 2, 3, 4, 5			
Reference Books:			
1. Data Structures: A Pseudo-code approach with C –Gilberg and Forouzan, 2nd edition, Cengage Learning, 2014.			
2. An Introduction to Data Structures with Applications- Jean-Paul Tremblay & Paul G. Sorenson, 2ndEdition, McGraw Hill, 2013.			
MOOCs:			
1. Data Structures and algorithms https://nptel.ac.in/courses/106/102/106102064/			

Activity:

1. Design and Implement a menu driven Program in C for the following Array operations:
 - a. Creating an Array of N Integer Elements
 - b. Display of Array Elements with Suitable Headings
 - c. Inserting an Element (ELEM) at a given valid Position (POS)
 - d. deleting an Element at a given valid Position (POS)
2. Write a C Program to create a Sequential file with at least 5 records, each record having the structure shown below:

USN	Name	Marks1	Marks2	Marks3
Non-zero positive integer	25 characters	Positive integer	Positive integer	Positive integer

Write necessary functions

- a. To display all the records in the file.
 - b. To search for a specific record based on the USN.
3. Write a menu driven C Program to arrange a pile of dinner plates that you encounter when you eat at the local cafeteria: When you remove a plate from the pile, you take the plate on the top of the pile. This is exactly the plate that was added most recently to the pile by the dishwasher. If you want the plate at the bottom of the pile, you must remove all the plates on top of it to reach it (use integers to number dinner plates).
4. Write recursive C Programs for
 - a. Searching an element in a given list of integers using the Binary search method.
 - b. Solving the Towers of Hanoi problem.
5. Write a C Program to evaluate a valid suffix/postfix expression using stack. Assume that the suffix/ postfix expression is read as a single line consisting of non-negative single digit operands and binary arithmetic operators. The arithmetic operators are + (add), - (subtract), * (multiply) and / (divide).
6. Write a menu driven C Program to simulate the working of a queue of vehicles on toll-tax bridge: The vehicle that comes first to the toll tax booth leaves the booth first. The vehicle that comes last leaves last. Therefore, it follows first-in-first-out (FIFO) strategy of queue (use integers to represent vehicles).
7. Write a menu driven C Program to simulate the working of a Circular Queue of integers using an array. Provide the following operations:
 - a. Insert
 - b. Delete
 - c. Display
8. Write a menu driven C Program using dynamic variables and pointers, to construct a Singly linked list of integers and perform insertion and deletion operations.
9. Write a menu driven C Program using dynamic variables and pointers to construct a Stack of integers using Singly linked list and to perform the following operations:
 - a. Push
 - b. Pop
 - c. Display
10. Write a menu driven C Program
 - a. To construct a binary search tree of integers.
 - b. To traverse the tree using all the methods i.e., In-order, Pre-order and Post-order.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2		✓												
CO3			✓										✓	
CO4			✓		✓				✓	✓				

Course Title	FUNDAMENTALS OF MANAGEMENT		
Course Code	22CB305	L-T-P-C	((3-0-0) 3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
<p>Course Objective: be able to describe the role of the company in the society, the different business cultures, and how companies are organized and managed from a business concept to ongoing operations with the support of strategic planning, formulation of objectives and management control.</p> <p>Course Outcomes (COs): Upon completion of the course, students shall be able to:</p>			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the importance of management for coordinating the industrial activities and to use the scientific management principles for effective utilization of resources	1	-
2.	Effectively plan, coordinate, control, lead and communicate for smooth functioning of the organization	10,11	-
3.	Illustrate the different categories of enterprise, organizational structure, responsibilities and authorities in an organization	1	-
4.	Implement international managerial functions in the Indian context and to take-up higher education	5,12	-
Course Contents:			
Module 1			08 Hours
<p>Management, Science, Theory and Practice: Definition of Management, Its nature and purpose, managerial skills and organizational hierarchy, Managing- Science or Art? Contributions of F.W. Taylor and Henry Fayol, Functions of managers, levels of management, Management and Society: Social responsibility of managers, Ethics of managing.</p> <p>Ownership of Enterprises: Proprietorship, Partnership, types, Joint stock Companies - Private and Public limited companies Public sector companies, Co-operative organizations, types, methods of raising capital.</p>			
Module 2			07 Hours
<p>Planning: Definition of planning, Types of plans, steps in planning, MBO, how to Set Objectives, Benefits and weakness of MBO Some Recommendations.</p> <p>Strategies, Policies and Planning Premises: Nature and Purpose of Strategies and Policies, TOWS matrix: A modern tool for analysis of the situation, Major kinds of strategies and policies.</p> <p>Decision Making: Importance and limitations of rational decision making, Rationality in decision making, Evaluation of alternatives, Selecting an alternative- three approaches, Programmed and Non-programmed decisions.</p>			
Module 3			08 Hours
<p>Organizing: The nature and purpose of organizing, Formal and informal organization. Organization levels and Span of management, a system approach to organization, principles of organization, principles of organization, Types of organization: line, military or scalar, functional, project/product/departmentation, matrix/grid.</p> <p>Staffing: Definition of Staffing, Systems approach to human resources, Situational factors affecting staffing. Selection- matching the person with the job, Skills and personal characteristics needed by managers, Selection process, Techniques and instruments, purpose of Performance appraisal.</p>			
Module 4			07 Hours
<p>Leading: Human factors in managing, , Motivations and motivators. Maslows Hierarchy of needs Theory, Herzberz motivation- Hygiene theory, mcgregors theory X and theory Y , Leadership: Leadership behavior and Leadership styles,</p> <p>Communication: Importance of Communication, Purpose of Communication, Communication process, Types of communication, Effective communication.</p> <p>International Management: Managerial functions in international business, Japanese</p>			

management and Theory Z.

Text Books:

1. **Principles of Management**, Harold Koontz, H. Weihrich, A.R. Aryasri, Tata McGraw-Hill, New Delhi.
2. **Industrial Engineering and Management**, OP Khanna, Dhanpat Rai and Sons.

Reference Books:

1. **Essentials of Management**, Harold Koontz, H. Weihrich, Tata McGraw-Hill, New Delhi.
2. **Management of Organizational Behaviour** Hershey Paul and Kenneth Blanchard, PHI.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc23_mg33/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2										✓	✓			
CO3	✓													
CO4					✓							✓		

CO2								✓		✓		✓		
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**Engineering Science Courses/Emerging Technology Courses/ Programming
Language Courses – III**

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	22CB307A	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: Design and develop java application programs using object-oriented concepts.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the concepts of OOP and Java constructs for the development of applications	1	-
2.	Analyze the given java program to make suitable changes and write the output	2	1
3.	Design and develop a java program, user interface to solve the given problem.	3	1
4.	Conduct practical experiments for demonstrating object oriented concepts through java.	3,5,9,10	-
Course Contents:			
Module 1			10 Hours
Introduction to OOP and Java: Overview of OOP, Object oriented programming paradigms, Features of Object Oriented Programming, Java Buzzwords, Overview of Java, Data Types, Variables and Arrays, Operators, Control Statements, Programming Structures in Java, Defining classes in Java, Constructors, Methods, Access specifiers, Static members, Java Doc comments			
Inheritance, Packages and Interfaces: Overloading Methods, Objects as Parameters, Returning Objects, Static, Nested and Inner Classes. Inheritance: Basics, Types of Inheritance, Super keyword, Method Overriding, Dynamic Method Dispatch, Abstract Classes, final with Inheritance. Packages and Interfaces: Packages, Packages and Member Access, Importing Packages Interfaces.			
Module 2			10 Hours
Exception Handling and Multithreading: Exception Handling basics, Multiple catch Clauses, Nested try Statements, Java's Built-in Exceptions, User defined Exception. Multithreaded Programming: Java Thread Model, creating a Thread and Multiple Threads, Priorities, Synchronization, Inter Thread Communication, Suspending, Resuming, and Stopping Threads, Multithreading. Wrappers, Auto boxing.			
Module 3			10 Hours
I/O, Generics, String Handling: I/O Basics, Reading and Writing Console I/O, Reading and Writing Files. Generics: Generic Programming, Generic classes, Generic Methods, Bounded Types, Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class. Files, Streams- Byte streams, Character streams, Text input/output, Binary input/output, File management using File class			
Module 4			10 Hours
GUI Programming with Swing: The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – Jbutton, JLabel, JTextField, JTextArea, simple Swing applications, Layout management – Layout manager types – border, grid and flow			
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, Examples: Handling Mouse and Key events, Adapter classes.			
Text Books:			
1. Java Fundamentals, A comprehensive Introduction by Herbert Schildt, Dale Skrien.TataMcGraw Hill Edition 2013 (Chapters 1,2,3,4,5,6,7,8,9,10,12)			
2. Java –The complete Reference, by Herbert Schildt Eight Edition Tata Mcgraw Hill Education (Chapter 19).			
Reference Books:			
1. Programming in JAVA2 by Dr K Somasundaram, Jaico publications			
2. Java Programming by Hari Mohan Pandey, Pearson Education, 2012			
MOOCs:			

1. <http://nptel.ac.in/courses/106106147/>
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=OKL_zftem4g
4. <https://www.coursera.org/specializations/object-oriented-programming>

Activity:

Write and execute the following programs in java

1. Get acquainted with java environment. Print different patterns of asterisk (*) using loops (e.g. triangle of *). Compare syntactical similarities and dissimilarities between Java and C++
2. Create a class Employee and encapsulate the data members. Create demo applications to illustrate different types of inheritance.
3. Create an Array of Employee class and initialize array elements with different employee objects. Understand the No. of objects on heap memory when any array is created.
4. Create a demo application to understand the role of access modifiers. Implement multilevel, multiple and hybrid inheritance using different packages.
5. Access/invoke protected members/methods of a class outside the package. Override finalize method to understand the behaviour of JVM garbage collector.
6. Create sample classes to understand boxing & unboxing.
7. Use different methods of java defined wrapper classes.
8. Create StringDemo class and perform different string manipulation methods.
9. Understand the difference between String / StringBuffer / StringBuilder.
10. Development of applications using AWT components

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2		✓											✓	
CO3			✓										✓	
CO4			✓		✓				✓	✓				

Course Title		PYTHON FOR DATA SCIENCE	
Course Code	22CB307B	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: utilize the python constructs and libraries to perform data analysis.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the python libraries to load, pre-process, analysis and visualize the data.	1, 5	-
2.	Analyze the given data and interpret the results using python libraries	2,5	1
3.	Develop a python program to solve the given problem	3,5	1
4.	Work collaboratively and demonstrate the applicability of python libraries to solve real world data science problems	9,10,12	-
Course Contents:			
Module 1			10 Hours
<p>Introduction to Python for data science: Basics of Python SPYDER (TOOL), Introduction Spyder, setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, commenting script files, Variable creation, Arithmetic and logical operators, Data types and associated operations Introduction to Data Science, Python for Data Science, Python Pandas, Python Numpy, Python Scikit-learn, Python Matplotlib</p> <p>Python Basics: Taking input in Python, Python, Output using print () function, Variables, expression condition and function, Basic operator in python</p> <p>Data Types: Strings, List, Tuples, Sets, Dictionary, Arrays, Loops, Loops and Control Statements (continue, break and pass) in Python, else with for, Functions in Python, Yield instead of Return, Python OOPs Concepts, Exception handling</p> <p>Sequence data types and associated operations Strings, Lists, Arrays, Tuples Dictionary, Sets, Range, NumPy and Array</p>			
Module 2			10 Hours
<p>Data Processing: Understanding Data Processing, Python: Operations on Numpy Arrays, Overview of Data Cleaning, Slicing, Indexing, Manipulating and Cleaning Pandas Dataframe, working with Missing Data in Pandas, Pandas and CSV, Python, Read CSV, Export Pandas dataframe to a CSV file, Pandas and JSON, Pandas, Parsing JSON Dataset, Exporting Pandas Dataframe to JSON File, working with excel files using Pandas</p> <p>Data Visualization : Data Visualization using Matplotlib, Style Plots using Matplotlib, Line chart in Matplotlib, Bar Plot in Matplotlib, Box Plot in Python using Matplotlib, Scatter Plot in Matplotlib, Heatmap in Matplotlib, Three-dimensional Plotting using Matplotlib, Time Series Plot or Line plot with Pandas, Python Geospatial Data, Other Plotting Libraries in Python, Data Visualization with Python Seaborn, Using Plotly for Interactive Data Visualization in Python, Interactive Data Visualization</p>			
Module 3			10 Hours
<p>Python Relational Database : Connect MySQL database using MySQL-Connector Python, Python: MySQL Create Table, Python MySQL – Insert into Table, Python MySQL – Select Query, Python MySQL – Update Query, Python MySQL – Delete Query, Python NoSQL Database, Python Datetime, Data Wrangling in Python, Pandas Group by: Summarising, Aggregating, and Grouping data, What is Unstructured Data?, Label Encoding of datasets, One Hot Encoding of datasets</p>			
Module 4			10 Hours
<p>Statistics : Measures of Central Tendency, Statistics with Python, Measuring Variance, Normal Distribution, Binomial Distribution, Poisson Discrete Distribution, Bernoulli Distribution, P-value, Exploring Correlation in Python, Create a correlation Matrix using Python, Pearson’s Chi-Square Test</p>			
Text Books:			
<p>1. Python for Data Analysis, Wes McKinney, 2nd edition, O’Reilly Media, ISBN: 978-1-491-95766-0, 2018.</p>			

2. Python Programming and SQL, Mark Reed
3. Introduction to Data Science: Practical Approach with R and Python, B Uma Maheshwari , R. Sujatha

Reference Books:

1. Introduction to Python for Data Science:Paul J. Deitel, Harvey M. Deitel, Harvey Deite

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc23_cs99/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓				✓									
CO2		✓			✓								✓	
CO3			✓		✓								✓	
CO4									✓	✓	✓			

Course Title	QUANTUM COMPUTING		
Course Code	22CB307C	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40
<p>Course Objective: The primary course objective is to equip students with a strong foundation in the mathematical prerequisites for quantum computation, including proficiency in linear algebra and complex numbers, wave functions, quantum superposition, and entanglement, essential for quantum computing applications.</p> <p>Course Outcomes (COs): Upon completion of the course, students shall be able to:</p>			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Discuss the fundamental principles of quantum mechanics, including wave functions, eigenvalues, and quantum superposition, as well as the mathematical tools of linear algebra and complex numbers used in quantum computation.	-	-
2.	Apply the fundamental principles of quantum mechanics and implement quantum circuits and quantum logic	1	1
3.	Analyse quantum algorithms and circuits built on actual quantum computers or simulators	2	-
4.	Collaborate effectively in teams and demonstrate the applications of quantum computers in real life	9,10	-
Course Contents:			
Module 1			10 Hours
<p>Mathematical Prerequisites for Quantum Computations: Representing and operating quantum systems by using mathematical methods. Linear algebra. Matrix operations; addition, multiplication, transpose of matrix, etc. Density matrix. Unitary matrices. Fundamental operations of complex numbers; addition, multiplication, conjugate of a complex number, Argand diagram etc.</p>			
Module 2			10 Hours
<p>Quantum Physics for Quantum Computations Wave function, Ortho-normalization condition of wave function, Operators, Eigen values and Eigen functions. Dirac bracket notation. Ket state and Hilbert space. Failure of Moore's Law. Principles of quantum mechanics for quantum computing; Quantum superposition and Quantum entanglement principles. EPR paradox and Bell's inequality. Additionally, Wave-particle dualism, Heisenberg Uncertainty Principle, Quantum tunnelling, etc. All the postulates of Quantum mechanics. Quantum realm and nonlocality. Quantum teleportation. Predictions of Quantum superposition states of quantum systems.</p>			
Module 3			10 Hours
<p>Linear algebra for Quantum Computations Difference between Classical and Quantum computers. Power of quantum computers; Reversible computation, parallel computation, exponential growth of computational power etc. Qubits, pure and mixed states of a qubit. Bloch sphere and single qubit quantum logic gates; Hadamard gate, Pauli's gates (X), Y) and Z), phase gate and other gate. Different operations of quantum logic gates on single qubit by the means of Bra-Ket and matrix operations. Multi qubit systems: Logic gates – CNOT gate, Swap gate, CZ gate, C phase gate, Taffoli gate, Fredkin (controlled swap) gate</p>			
Module 4			10 Hours
<p>Approaches of Quantum Computers Architectures Physical realization of Quantum superposition and quantum entanglement; Superconducting Qubits, Trapped Ion Qubits, Topological Qubits, Photonic Qubits, Nuclear Magnetic Resonance (NMR), Silicon Spin Qubits, Adiabatic Quantum Computers, Hybrid Quantum-Classical Systems. Quantum simulators; IBM Qiskit. Quantum error correction.</p>			
Text Books:			
<ol style="list-style-type: none"> 1. Quantum computation and quantum information- Michael A. Nielsen, Isaac L. Chuang - Cambridge University Press, 2004. 2. Modern Quantum Mechanics, J. J. Sakurai and Jim Napolitano. 3. Quantum Computing: From Linear Algebra to Physical Realizations, Mikio Nakahara and Tetsuo Ohmi. 			

Reference Books:

1. Quantum Algorithms by Ronald de Wolf, first edition.
2. Quantum Hardware by Merzbacher and Styer, first edition.
3. Quantum Information Theory and the Foundations of Quantum Mechanics by Christopher G. Timpson, first edition.
4. Quantum Error Correction by Daniel A. Lidar and Todd A. Brun, first edition.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview

Activity

1. Apply single & multiple quantum logic gates in an actual quantum computer and interpret its result.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	✓												✓	
CO3		✓												
CO4									✓	✓				

Course Title	HUMAN RESOURCE MANAGEMENT		
Course Code	22CB407D	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50 (30-20-0)
Course Objective: To introduce the student to the theory, concepts, and business application of human resources research, data, metrics, systems, analyses, and reporting.			
Course Outcomes (COs): At the end of course, student will be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	solve case studies on Workplace Ethics Discussion on “How to have/ evaluate the performance of the students	1	-
2.	visit organizations and find out the problems and causes for unethical behavior at Workplace.	1	-
3.	Identify the important HR metrics used in manufacturing companies..	2,5	-
4.	collect manpower data of your institute and prepare HR Dashboards.	2,4	-
Course Contents:			
Module 1			10Hours
HR Analytics in perspective: Role of Analytics, Defining HR Analytics, HR Analytics: The Third Wave for HR value creation, HR Measurement journey in tune with HR maturity journey Understanding the organizational system (Lean) , Locating the HR challenge in the system , Valuing HR Analytics in the organizational system, Typical problems (working session)			
HRA Framework: Current approaches to measuring HR and reporting value from HR contributions, Strategic HR Metrics versus Benchmarking, HR Scorecards & Workforce Scorecards and how they are different from HR Analytics, HR Maturity Framework: From level 1 to level 5, HR Analytics Frameworks: (a) LAMP framework; (b) HCM: 21 Framework and (c) Talent ship Framework, 5 overarching components of an effective Analytics framework.			
Module 2			10 Hours
Basics of HR Analytics: what is Analytics, Evolution, Analytical capabilities, Analytic value chain, Analytical Model, Typical application of HR analytics.			
Predictive Analytics: Steps involved in predictive analytics: Determine key performance indicator, analyse and report data, interpreting the results and predicting the future. Metrics and Regression analysis and Causation.			
Module 3			10 Hours
Human Resources Development –Training and Development Methods - Design & Evaluation of T&D Programmes - Career Development - Promotions and Transfers - Personnel Empowerment including Delegation - Retirement and Other Separation Processes. Financial Compensation- - Productivity and Morale - Principal Compensation Issues & Management - Job Evaluation - Productivity, Employee Morale and Motivation - Stress Management - Quality of Work Life.			
Module 4			10 Hours
HR Matrices : Defining metrics, Demographics, data sources and requirements, Types of data, tying data sets together, Difficulties in obtaining data, ethics of measurement and evaluation. Human capital analytics continuum.			
HR Dashboards Statistical software used for HR analytics: MS-Excel, IBM- SPSS, IBMAMOS, SAS, and R programming and data visualization tools such as Tableau, Plotly, Click view and Fusion Charts.			
Text Books :			
1. Moore, McCabe, Duckworth, and Alwan. The Practice of Business Statistics: Using Data for			

Course Title	Social Connect & Responsibility		
Course Code	22CB308	L-T-P-C	(0-0-2) 1
Exam Hrs.	--	Hours / Week	2
SEE	--	Total Hours	24

Course Objective: Provide a formal platform for students to communicate and connect with their surroundings and create a responsible connection with society

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Work collaboratively as a member and a leader and demonstrate an understanding of the environmental, agriculture and sustainability aspects related to societal and technological practices adapting to technological advancements while adhering to ethical and professional norms	6, 7, 8, 9, 11, 12	-
2.	Produce well-structured documentaries, photo blogs, and presentations that effectively convey the essence of the learned experiences and cultural connections	5, 10	-

Course Contents:

Module 1	08 Hours
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Plantation and adoption of a tree: Plantation of a tree that will be adopted by a group of students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

Module 2	07 Hours
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Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photoblog and documentary on evolution and practice of various craft forms.

Module 3	08 Hours
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Organic farming and waste management: Usefulness of organic farming, wet waste management in neighbouring villages, and implementation in the campus.

Module 4	07 Hours
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Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices. Food Walk City's culinary practices, food lore, and indigenous materials of the region used in cooking.

Course Conduction

A total of 14-20 hrs engagement per semester is required for the course. Students will be divided into teams and each team will be handled by two faculty mentors. Faculty mentors will design the activities for evaluation.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE)

After completion of the social connect, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						✓	✓	✓	✓		✓	✓		
CO2					✓					✓				

Ability Enhancement Course-III

Course Title	Data analytics with Excel		
Course Code	22CB358A	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2
SEE	50 Marks	Total Hours	24
List of Experiments:			
<ol style="list-style-type: none"> Getting Started with Excel: Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions. Working with Data: Importing data, Data Entry & Manipulation, Sorting & Filtering. Working with Data: Data Validation, Pivot Tables & Pivot Charts. Data Analysis Process: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs. Cleaning Data with Text Functions: use of UPPER and LOWER, TRIM function, Concatenate. Cleaning Data Containing Date and Time Values: use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions. Conditional Formatting: formatting, parsing, and highlighting data in spreadsheets during data analysis. Working with Multiple Sheets: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports. Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data. Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data. Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts. Generation of report & presentation using Autofilter & macro. 			
Text Books:			
<ol style="list-style-type: none"> Berk & Carey - Data Analysis with Microsoft® Excel: Updated for Office 2007®, Third Edition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4 Wayne L. Winston - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180. Aryan Gupta - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel) 			
Reference Books:			
<ol style="list-style-type: none"> "Excel 2019 Bible" by Michael Alexander and Richard Kusleika "Data Analysis Using Excel" by Michael R. Middleton "Effective Data Visualization" by Stephanie D. H. Evergreen 			
MOOCs:			
<ol style="list-style-type: none"> https://www.mygreatlearning.com/academy/learn-for-free/courses/data-analytics-using-excel 			

Course Title	R PROGRAMMING		
Course Code	22CB358B	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2 Hrs
SEE	50 Marks	Total Hours	28
<ol style="list-style-type: none"> 1. Introduction: R interpreter, Introduction to major R data structures like vectors, matrices, arrays, list and data frames, 2. Control Structures, vectorized if and multiple selection, functions. 3. Installing, loading and using packages: Read/write data from/in files, extracting data from web-sites, Clean data, Transform data by sorting, adding/removing new/existing columns, centering, 4. scaling and normalizing the data values, converting types of values, using string in-built functions, 5. Statistical analysis of data for summarizing and understanding data, 6. Visualizing data using scatter plot, line plot, bar chart, histogram and box plot. 7. Designing GUI: Building interactive application and connecting it with database. 8. Building Packages 			
Text Books:			
<ol style="list-style-type: none"> 1. Cotton, R., Learning R: a step by step function guide to data analysis. 1st edition. O'reilly Media Inc 			
Reference Books:			
<ol style="list-style-type: none"> 1. Gardener, M.(2017). Beginning R: The statistical programming language, WILEY 2. Lawrence, M., & Verzani, J. (2016). Programming Graphical User Interfaces in R. CRC press. (ebook) 			

Course Title	DATA VISUALIZATION Using Tableau and Power BI		
Course Code	22CB358C	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2 Hrs
SEE	50 Marks	Total Hours	28

Tableau

1. Tableau Course Material
2. Learn Tableau Basic Reports
3. Learn Tableau Charts
4. Custom SQL
5. Learn Tableau Advanced Reports
6. Learn Tableau Calculations & Filters
7. Learn Tableau Dashboards
8. Tableau Server UI

Power BI

1. SQL Server Introduction
2. Basic Report Design
3. Visual Sync, Grouping
4. Hierarchies, Filters
5. Bookmarks, Azure, Modelling
6. Visualization Properties
7. Power Query Level 1,2,3
8. DAX Functions - Level 1,2,3
9. Power BI Cloud – 1,2
10. Excel & RLS
11. Report Server, RDL
12. Power BI Service & Power BI Mobile
13. Power BI and Excel Together

Course Title	Business Communication		
Course Code	22CB358D	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2 Hrs
SEE	50 Marks	Total Hours	28
<ol style="list-style-type: none"> 1. Business Communication components, Types, formal communication network, Work team communication, variables, goal, conflict resolution, nonverbal communication, Cross cultural communication, Business meetings, Business Etiquette. 2. Aspects of technical communication, forms, importance, skills, linguistic ability, style in technical communication. 3. Understanding Corporate Communication, Employee Communication, Managing Government Relations, Writing for Media and Media Relations. 4. Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. 5. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media. 6. Corporate Communication in Brand Promotion, Financial Communication, Crises Communication. 7. Report writing: Characterizing & business reports, Types and forms & reports, 8. Project proposals, collection of data, tables constitution, charts, writing the report, documenting the sources, proof reading. 9. Business Presentation: Written and oral presentation, work, team presentation, Delivering the business presentation visual aids, slides, electronic presentation, hand-outs, delivering the presentation. 10. career planning, preparing Resume, job applications, preparation for a job interview, employment interviews, follow-up. 			
Text Books:			
1. Scot Ober, Contemporary business communication, Biztantra, 2014, ISBN-10: 9780198061847			
Reference Books:			
1. Lesiler & Flat lay, Basic Business communication, Tata Mc Graw Hill, 2010, ISBN-10: 9780072537536			

SEMISTER -IV

Course Title		LINEAR ALGEBRA	
Course Code	22CB401	L-T-P-C	(2-2-0) 3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: Students will be trained to acquire knowledge in linear algebra and its applications.			
Course Outcomes (COs): Having studied this course, students will be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply suitable solution procedure to solve the linear models of business, engineering, economics and apply matrix factorization to applications such as computer graphics.	1,2	-
2.	To compute suitable matrices arising in magnification, rotation of images using the knowledge of vector space, matrix of linear transformations.	1,2	-
3.	Analyze the application-oriented problems connected with difference equations, Markov chain, discrete dynamical systems by using the concept of Eigen values, Eigen vectors.	1,2	-
4.	Apply the techniques of singular value decomposition, PCA, to analyze the process of data compression/image processing.	1,2	-
Course Contents:			
Module 1			07 Hours
<p>Linear Algebra: Importance of Matrices in engineering. Rank of a matrix. Consistency of non-homogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors. Applications of solution of system of equations to balance the chemical equations. Traffic flow problem. To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician.</p> <p>Self-Study- linear models in business and engineering, Partitioned matrices, Matrix factorization, the Leontief input –output model, application to computer graphics</p>			
Module 2			10 Hours
<p>Vector space, subspace, basis of a vector space, dimension of a vector space, introduction to linear transformation, rank, nullity of a linear transformations, matrix of a linear transformation. Special matrices-matrix of rotation, reflection, translation.</p> <p>Self-Study- To find the matrix of transformation when the image of some points is given.</p>			
Module 3			10 Hours
<p>Eigen value, Eigen vectors, applications of diagonalization, Jordan canonical form. application to discrete dynamical systems- coupled differential equations governing the electrical circuits systems, applications to difference equations, applications to web page ranking.</p> <p>Self-Study- Stretching of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).</p>			
Module 4			10 Hours
<p>Orthogonal sets, orthogonal projections, Gram Schmidt process, QR-factorization, lest square problems, multiple regression through matrix approach, singular value decomposition theorem, examples. Principal component analysis- applications of PCA to data compression, image processing.</p> <p>Self-Study- Application of eigen-value eigen-vectors in Signature testing, Face recognition. Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors.</p>			
Note:			
<ol style="list-style-type: none"> 1. Theorems and properties without proof. Applicable to all the modules. 2. Self study part is not included for Semester End Examination. 			
Text Books:			
<ol style="list-style-type: none"> 1. Linear Algebra and its Applications, David C. Lay, Steven R. Lay and J.J. Mc Donald: 5th Edition, Pearson Education Ltd., 2015. 			

Course Title		THEORETICAL FOUNDATIONS OF COMPUTATION	
Course Code	22CB402	L-T-P-C	(2-2-0) 3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40
<p>Course Objective: The course provides a basic understanding of theory of computation and students will be able to design various kinds of automata, formal languages and grammars as a first step towards learning advanced topics such as compiler design.</p> <p>Course Outcomes (COs): Upon completion of the course, students shall be able to:</p>			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understand the fundamental concepts of formal languages and automata theory	1	-
2.	Design DFAs, NFAs, and perform conversions among them	3	-
3.	Design regular expressions, context free grammars, Push Down Automata and Turing machines for different levels of formal languages	3	-
4.	Construct and simulate different kinds of automata using simulation tool	5	-
Course Contents:			
Module 1			08 Hours
<p>Introduction to Finite Automata: The Central Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Epsilon-Transitions, Equivalence of NFA and DFA. Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions</p>			
Module 2			07 Hours
<p>Regular Expressions and Languages (Contd.): Pumping lemma for regular languages, Applications of Regular Expressions, Equivalence and Minimization of Automata. Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context Free Grammars, Ambiguity in Grammars.</p>			
Module 3			08 Hours
<p>Pushdown Automata: Introduction and construction of Pushdown Automata, Acceptance by final state and empty stack, Equivalence of PDA's and CFG's Turing Machines: Introduction to Turing Machine, Construction of Turing Machine.</p>			
Module 4			07 Hours
<p>Turing Machines (contd.): Programming Techniques for Turing Machines, Restricted Turing machines, Turing Machines and Computers, The Universal Turing Machine, Introduction to undecidable problems, Post's Correspondence Problem.</p>			
Text Books:			
<p>1. J.P.Hopcroft, Rajeev Motwani, J.D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 3rd Edition, 2007</p>			
Reference Books:			
<p>1. John Martin, "Introduction to Languages and Theory of Computation", Tata McGraw-Hill, 2003. 2. Peter Linz, "An Introduction to Formal Languages and Automata", 4th Edition, Narosa Publishing House, 2007 An Introduction to Data Structures with Applications- Jean-Paul Tremblay & Paul G. Sorenson, 2nd Edition, McGraw Hill, 2013.</p>			
MOOC Course:			
<p>1. Theory of Computation https://onlinecourses.nptel.ac.in/noc22_cs63</p>			
Course Articulation Matrix:			
Course Outcomes	Program Outcomes [POs]		

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS		
Course Code	22CB403	(L-T-P)C	(3-0-2) 4
Exam	3Hrs	Hours/Week	5
SEE	50 Marks	Total Hours	36L+14P
Course Objective: Students will be able to design algorithms using various strategies and analyze it mathematically.			
Course outcomes: At the end of course, student will be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply various algorithm design techniques to solve the given problem.	1	-
2.	Analyse the time complexity of the algorithm using asymptotic notations.	2	-
3.	Differentiate tractable & intractable problems & apply techniques that help to cope up with limitation of algorithm power.	3	-
4.	Conduct experiments to implement the designed algorithms	3, 5	-
Course Contents:			
Module 1			10 Hours
Introduction: Notion of Algorithm, Fundamentals of algorithmic problem solving. Fundamentals of the Analysis of Algorithm Efficiency: Analysis framework, Asymptotic notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms, Examples. Brute Force: Selection Sort and Bubble Sort, Sequential Search and String Matching, Exhaustive search.			
Module 2			10 Hours
Divide-and-Conquer: Binary Search, Merge Sort, Quick Sort, Binary tree traversals and related properties, Multiplication of large integers, Strassen's Matrix multiplication. Decrease-and-Conquer: Insertion Sort, Depth First and Breadth First Search, Topological sorting, Algorithms for generating combinatorial objects.			
Module 3			10 Hours
Transform-and-Conquer: Pre-sorting, Balanced Search Trees, Heaps and Heap Sort, Problem reduction. Space and Time Trade-off: Sorting by counting, Input enhancement in string Matching (only Horspool), Hashing. Dynamic Programming: Computing a Binomial coefficient, Warshall's Algorithm, Floyd's algorithms, The Knapsack problem.			
Module 4			10 Hours
Greedy Technique: Prim's algorithm, Kruskal's algorithm, Dijkstra's algorithm, Huffman trees, Limitations of Algorithm Power: Lower-bound arguments, Decision trees, P, NP and NP-Complete Problems, coping with the Limitations of Algorithm Power: Backtracking, Branch-and-bound.			
Practical Component/Tutorial:			
Guided Experiments			
Implement the following using C/Python.			
<ol style="list-style-type: none"> 1. Employees in an organization need to be grouped for a tournament based on their ages. Sort the ages using Merge sort and find the time required to perform the sorting. 2. Students in a department need to be selected for a high jump competition based on their height (integer values only). Sort the heights of students using Quick sort and find the time required for the sorting. 3. Print all the nodes reachable from a given starting node in a graph using Depth First Search method and Breadth First Search. Also check whether a graph is connected. 4. Obtain the topological ordering of vertices in a given digraph. 5. Implement Horspool algorithm for String Matching. 6. Sort a given set of elements using the Heap sort method. 7. Implement Floyd's algorithm and Warshall's algorithm for a given graph. 8. There are n different routes from hostel to college. Each route incurs some cost. Find 			

Course Title	Entrepreneurship and Business Development		
Course Code	22CB404	L-T-P-C	(3-0-0) 3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
<p>Course Objective: Entrepreneurship and businesses are the basis for economic growth all over the world. They play an important role in employment, income and societal changes, particularly in transition economies.</p> <p>Course Outcomes (COs): Upon completion of the course, students shall be able to:</p>			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the structure of modern business enterprise, role of industries and government policies in developing business	3	-
2.	Classify the different types of entrepreneurs and identify the characteristics of a successful entrepreneur	2	-
3.	Motivate to take-up entrepreneurship	3	-
4.	Apply the stages involved in starting an enterprise, develop and implement a business plan	3	-
Course Contents:			
Module 1			08 Hours
<p>Modern Business Enterprises: Role of small scale industries, Concept and definitions of SSI, Government policy and Development of the small scale sector in India, Growth & Performance of small scale industries in India. Problems for small-scale industries, Prospects for small scale industries in a free economy.</p> <p>Entrepreneurship: Importance of Entrepreneurship, concepts of Entrepreneurship, characteristics of a successful Entrepreneur, classification of Entrepreneurs, Myths of entrepreneurship, Entrepreneurial development models, Profiles of successful entrepreneurs.</p>			
Module 2			07 Hours
<p>Women Entrepreneurs: Women Entrepreneurship defined, Women entrepreneurship environment, challenges in the path of women entrepreneurship, Strategies for the development of women entrepreneurs, Institutions supporting women entrepreneurs in India, women entrepreneurs in India, Any two case studies Institutions</p> <p>Supporting Small Business Enterprises: Introduction, central level institutions, State level institutions. Other agencies, Industry associations</p>			
Module 3			08 Hours
<p>Setting up a Small Business Enterprise: Identifying the business opportunity, Business opportunities in various sectors. Formalities for setting up a small business enterprise</p> <p>Sickness in Small Business Enterprises: Definition of sickness and Present status of sickness of SSIs in India, Criteria for identifying sickness/incipient sickness, causes for sickness/incipient sickness in SSI, Symptoms of sickness, Cures for SSIs sickness, Any two case studies</p>			
Module 4			07 Hours
<p>Strategic Management in Small Business: Organization life cycle, strategic management, the essence of business ethics, Financial management in small business: Importance of financial management, working capital management.</p> <p>Family Business: Importance of family business, Various types of family business, History of the family business, Responsibility and rights of family shareholders of a family business, strategies for improving the capability of a family business, management development plan in family business, family reunion games promote family value, how to save the family business.</p>			
<p>Text Books: Entrepreneurship Development-Small Business Enterprises, Poornima. M.Charatimat, Pearson Education in South Asia</p>			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Dynamics of entrepreneurial development and Management, Vasant Desai, Himalayan Publishing House Entrepreneurship development, S.S.Khanka, S.Chand& Co, New Delhi. 			
MOOC's:			
Activity:			20 Hours
Further, the topic for class discussion will be mentioned beforehand.			

Course Title	Data Base Management System		
Course Code	22CB405	L-T-P-C	(3-0-0) 3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will acquire the concepts of databases, and application of SQL for solving problems.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the concepts of SQL and relational algebra to find solution to the given problem	1	-
2.	Analyze a given scenario and use appropriate database technique	2	-
3.	Design ER diagram or database for a given scenario	3	1
4.	Conduct experiments of database using modern tools: Oracle, MongoDB, MySQL	3, 5, 9, 10, 12	-
Course Contents:			
Module 1			10 Hours
Introduction: Introduction, an example, Characteristics of Database approach, Actors on the Screen, Workers Behind the Scene, Advantages of Using DBMS Approach. Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.			
Entity-Relationship 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.			
Module 2			10 Hours
Relational Model and Relational Algebra: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra, Relational Database Design Using ER- to-Relational Mapping. SQL: SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Basic Queries in SQL.			
Module 3			10 Hours
SQL(contd.): More Complex SQL Queries, Insert Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Views (Virtual Tables) in SQL, Schema Change Statements in SQL.			
Database Design: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.			
Module 4			10 Hours
Transaction Management: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock - Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery. Crash Recovery Techniques.			
NoSQL: An overview of NoSQL, Characteristics of NoSQL, NoSQL storage types, Advantages and Drawbacks of NoSQL			
Text Books:			
1. "Fundamentals of Database Systems", Elmasri and Navathe, 7th Edition, Addison-Wesley,2015.			
2. " Database Management Systems", Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, McGraw-Hill,2007			
Reference Books:			
1. Database System Concepts, Silberschatz, Korth and Sudharshan, 5th Edition, Mc-Graw Hill, 2006.			
2. An Introduction to Database Systems, C.J. Date, A. Kannan, S. Swamynatham, Pearson education, 8 th Edition, 2006.			

MOOC Course:

1. https://onlinecourses.swayam2.ac.in/cec19_cs05/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs46/preview

Practical Component

1. Consider the following schema: EMPLOYEE (Ename, Ssn, Bdate, Sex, Address, salary, Mgrssn, Dno) DEPARTMENT (Dname, Dnumber, Mgrssn, Mgr_start_date) PROJECT (Pname, Pnumber, Plocation, Dnum) WORKS_ON (Essn, Pno, Hours) DEPENDENT (Essn, Dependent_name, Sex) Create above tables by specifying primary key, foreign key and other suitable constraints.
Insert atleast 5 tuples to each created table.
 - i. Retrieve the name and address of all employees who work for the "ISE" department.
 - ii. For each employee, retrieve the employee's name and the name of his or her immediate supervisor
 - iii. Find the sum of all salaries of all employees
 - iv. For each department, retrieve the department number, the number of employees in the department and their average salary.
2. Consider the following relation schema: SAILORS (Sid: integer, Sname: string, Rating: integer, Age: real) BOATS (Bid: integer, Bname: string, Color: string) RESERVES (sid: integer, bid: integer, Day: date) Create above tables by specifying primary key, foreign key and other suitable constraints. Insert atleast 5 tuples to each created table. Design a database to satisfy the above requirements and answer following queries
 - i. Find all sailors with a rating above 7
 - ii. Find the names of sailors who have reserved boat number 103
 - iii. Find the names of sailors who have reserved a red boat
 - iv. Find the names of sailors who have reserved a red or a green boat
3. Consider the following relation schema: STUDENT (Snum: integer, Sname: string, Major: string, Level: string, Age: integer) CLASS (Cname: string, meets at: string, Room: string, Fid: integer) ENROLLED (Snum: integer, Cname: string) FACULTY (Fid: integer, Fname: string, Deptid: integer) The meaning of these relations is straightforward; for example, enrolled has one record per student-class pair such that the student is enrolled in the class. Level is a two-character code with 4 different values (example: Junior: JR etc) Write the following queries in SQL. No duplicates should be printed in any of the answers.
 - i. Find the names of all Juniors (level = JR) who are enrolled in a class taught by Prof. Harshith
 - ii. Find the names of all classes that either meet in room R128 or have five or more Students enrolled.
 - iii. Find the names of all students who are enrolled in two classes that meet at the same time.
 - iv. Find the names of faculty members who teach in every room in which some class is taught.
4. Consider the relation schema for book dealer database: AUTHOR (Author-id:int, Name: string, City: string, Country: string) PUBLISHER (Publisher-id:int, Name: string, City: string, Country: string) CATALOG (Book-id: int, Title: string, Author-id: int, Publisher-id: int, Category-id: int, Year: int, Price: int) CATEGORY (Category-id: int, Description: string) ORDER-DETAILS (Order-no: int, Book-id: int, Quantity: int) Create the above tables by properly specifying the primary keys and the foreign keys. Enter at least five tuples for each relation.
 - i. Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2000.
 - ii. Find the author of the book which has maximum sales.

- iii. Demonstrate how you increase the price of books published by a specific publisher by 10%
 - iv. List any department that has all its adopted books published by a specific publisher
5. Consider the 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) Write SQL queries to Create the above tables by properly specifying the primary keys and the foreign keys. Enter at least five tuples for each relation.
- i. List the titles of all movies directed by 'Hitchcock'.
 - ii. Find the movie names where one or more actors acted in two or more movies.
 - iii. List all actors who acted in a movie before 2000 and also in a movie after 2015.
 - iv. Update rating of all movies directed by 'Steven Spielberg' to
6. Consider the following database for a banking enterprise BRANCH (branch-name: String, branch-city: String, assets: real) ACCOUNTS (accno: int, branch-name: String, balance: real) DEPOSITOR (customer-name: String, customer-street: String, customer-city: String) LOAN (loan-number: int, branch-name: String, amount: real) BORROWER (customer-name: String, loan-number: int) Create the above tables by properly specifying the primary keys and the foreign keys. Enter at least five tuples for each relation.
- i. Find all the customers who have at least two accounts at the Main branch.
 - ii. Find all the customers who have an account at all the branches located in a specific city.
 - iii. Demonstrate how you delete all account tuples at every branch located in a specific city.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2		✓												
CO3			✓										✓	
CO4			✓		✓				✓	✓		✓		

Course Title	WEB APPLICATION DEVELOPMENT LABORATORY		
Course Code	22CB406	L-T-P-C	(0-0-2) 1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	40
Course Objective:			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the basic web development constructs to build the webpages	1	-
2.	Analyze the given scenario and build the webpage using suitable web development techniques	2	-
3.	Design and develop interactive webpages	3	1
4.	Create an end-to-end webpages connected to database using modern tools and present the results	4, 5, 9, 10, 12	1
Course Contents:			
List of Experiments			
<ol style="list-style-type: none"> 1. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient 2. 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. 3. Write a JavaScript code that displays text “TEXT-GROWING” with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays “TEXT-SHRINKING” in BLUE color. Then the font size decreases to 5pt. 4. Develop and demonstrate a HTML5 file that includes JavaScript script that uses functions for the following problems: <ol style="list-style-type: none"> a. Parameter: A string Output: The position in the string of the left-most vowel b. Parameter: A number Output: The number with its digits in the reverse order 5. Design an XML document to store information about a student in an engineering college affiliated to VTU. The information must include USN, Name, and Name of the College, Branch, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document. 6. Write a PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings. 7. Write a PHP program to display a digital clock which displays the current time of the server. 8. Write the PHP programs to do the following: <ol style="list-style-type: none"> a. Implement simple calculator operations. b. Find the transpose of a matrix. c. Multiplication of two matrices. d. Addition of two matrices. 9. Write a PHP program named states.py that declares a variable state with value "Mississippi 			

Alabama Texas Massachusetts Kansas". write a PHP program that does the following:

- a. Search for a word in variable states that ends in xas. Store this word in element 0 of a list named statesList.
- b. Search for a word in states that begins with k and ends in s. Perform a caseinsensitive comparison. [Note: Passing re.Ias a second parameter to method compile performs a case-insensitive comparison.] Store this word in element1 of states List.
- c. Search for a word in states that begins with M and ends in s. Store this word in element 2 of the list.
- d. Search for a word in states that ends in a. Store this word in element 3 of the list.

10. Write a PHP program to sort the student records which are stored in the database using selection sort.

Text Books:

1. Robert W Sebesta, "Programming the World Wide Web", 8th Edition, Pearson Edition, 2014.

Reference Books:

1. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2014.
2. James Lee, Brent Ware, "Open Source Web Development with LAMP", Pearson Education, 2013.

MOOCS:

1. https://online-degree.swayam2.ac.in/mri22_01_d03_s1_el10/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2		✓												
CO3			✓										✓	
CO4				✓	✓				✓	✓		✓	✓	

ENGINEERING SCIENCE COURSE/ EMERGING
TECHNOLOGY COURSE/ PROGRAMING LANGUAGE
COURSE

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	22CB407A	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50 (30-20-0)
Course Objective: Design and develop java application programs using object-oriented concepts.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the concepts of OOP and Java constructs for the development of applications	1	-
2.	Analyze the given java program to make suitable changes and write the output	2	1
3.	Design and develop a java program, user interface to solve the given problem.	3	1
4.	Conduct practical experiments for demonstrating object oriented concepts through java.	3,5,9,10	-
Course Contents:			
Module 1			08 Hours
<p>Introduction to OOP and Java : Overview of OOP, Object oriented programming paradigms, Features of Object Oriented Programming, Java Buzzwords, Overview of Java, Data Types, Variables and Arrays, Operators, Control Statements, Programming Structures in Java, Defining classes in Java, Constructors, Methods, Access specifiers, Static members, Java Doc comments</p> <p>Inheritance, Packages and Interfaces: Overloading Methods, Objects as Parameters, Returning Objects, Static, Nested and Inner Classes. Inheritance: Basics, Types of Inheritance, Super keyword, Method Overriding, Dynamic Method Dispatch, Abstract Classes, final with Inheritance. Packages and Interfaces: Packages, Packages and Member Access, Importing Packages Interfaces.</p>			
Module 2			07 Hours
<p>Exception Handling and Multithreading: Exception Handling basics, Multiple catch Clauses, Nested try Statements, Java's Built-in Exceptions, User defined Exception. Multithreaded Programming: Java Thread Model, creating a Thread and Multiple Threads, Priorities, Synchronization, Inter Thread Communication, Suspending, Resuming, and Stopping Threads, Multithreading. Wrappers, Auto boxing.</p>			
Module 3			08 Hours
<p>I/O, Generics, String Handling: I/O Basics, Reading and Writing Console I/O, Reading and Writing Files. Generics: Generic Programming, Generic classes, Generic Methods, Bounded Types, Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class. Files, Streams- Byte streams, Character streams, Text input/output, Binary input/output, File management using File class</p>			
Module 4			07 Hours
<p>GUI Programming with Swing: The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – Jbutton, JLabel, JTextField, JTextArea, simple Swing applications, Layout management – Layout manager types – border, grid and flow</p> <p>Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, Examples: Handling Mouse and Key events, Adapter classes.</p>			
Text Books :			
<ol style="list-style-type: none"> 1. Java Fundamentals, A comprehensive Introduction by Herbert Schildt, Dale Skrien. Tata McGraw Hill Edition 2013 (Chapters 1,2,3,4,5,6,7,8,9,10,12) 2. Java –The complete Reference, by Herbert Schildt Eight Edition Tata Mcgraw Hill Education (Chapter 19). 			
Reference Books:			
<ol style="list-style-type: none"> 1. Programming in JAVA2 by Dr K Somasundaram ,Jaico publications 2. Java Programming by Hari Mohan Pandey, Pearson Education, 2012 			
MOOCs:			
1. http://nptel.ac.in/courses/106106147/			

2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. <https://www.coursera.org/specializations/object-oriented-programming>

20 Hours

Activity:

Write and execute the following programs in java

1. Get acquainted with java environment. Print different patterns of asterisk (*) using loops (e.g. triangle of *). Compare syntactical similarities and dissimilarities between Java and C++
2. Create a class Employee and encapsulate the data members., Create demo applications to illustrate different types of inheritance.
3. Create an Array of Employee class and initialize array elements with different employee objects. Understand the No. of objects on heap memory when any array is created.
4. Create a demo application to understand the role of access modifiers. Implement multilevel, multiple and hybrid inheritance using different packages.
5. Access/invoke protected members/methods of a class outside the package. Override finalize method to understand the behavior of JVM garbage collector.
6. Create sample classes to understand boxing & unboxing.
7. Use different methods of java defined wrapper classes.
8. Create String Demo class and perform different string manipulation methods.
9. Understand the difference between String / String Buffer / String Builder.
10. Development of applications using AWT components

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓													
CO2		✓											✓	
CO3			✓										✓	
CO4			✓		✓				✓	✓				

Course Title	PYTHON FOR DATA SCIENCE		
Course Code	22CB407B	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: utilize the python constructs and libraries to perform data analysis.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the python libraries to load, preprocess, analysis and visualize the data.	1, 5	-
2.	Analyze the given data and interpret the results using python libraries	2,5	1
3.	Develop a python program to solve the given problem	3,5	1
4.	Work collaboratively and demonstrate the applicability of python libraries to solve real world data science problems	9,10,12	-
Course Contents:			
Module 1			10 Hours
<p>Introduction to Python for data science: Basics of Python SPYDER (TOOL), Introduction Spyder, setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, commenting script files, Variable creation, Arithmetic and logical operators, Data types and associated operations Introduction to Data Science, Python for Data Science, Python Pandas, Python Numpy, Python Scikit-learn, Python Matplotlib</p> <p>Python Basics: Taking input in Python, Python, Output using print () function, Variables, expression condition and function, Basic operator in python</p> <p>Data Types: Strings, List, Tuples, Sets, Dictionary, Arrays, Loops, Loops and Control Statements (continue, break and pass) in Python, else with for, Functions in Python, Yield instead of Return, Python OOPs Concepts, Exception handling</p> <p>Sequence data types and associated operations Strings, Lists, Arrays, Tuples Dictionary, Sets, Range, NumPy and Array</p>			
Module 2			10 Hours
<p>Data Processing: Understanding Data Processing, Python: Operations on Numpy Arrays, Overview of Data Cleaning, Slicing, Indexing, Manipulating and Cleaning Pandas Dataframe, working with Missing Data in Pandas, Pandas and CSV, Python, Read CSV, Export Pandas dataframe to a CSV file, Pandas and JSON, Pandas, Parsing JSON Dataset, Exporting Pandas Dataframe to JSON File, working with excel files using Pandas</p> <p>Data Visualization : Data Visualization using Matplotlib, Style Plots using Matplotlib, Line chart in Matplotlib, Bar Plot in Matplotlib, Box Plot in Python using Matplotlib, Scatter Plot in Matplotlib, Heatmap in Matplotlib, Three-dimensional Plotting using Matplotlib, Time Series Plot or Line plot with Pandas, Python Geospatial Data, Other Plotting Libraries in Python, Data Visualization with Python Seaborn, Using Plotly for Interactive Data Visualization in Python, Interactive Data Visualization</p>			
Module 3			10 Hours
<p>Python Relational Database : Connect MySQL database using MySQL-Connector Python, Python: MySQL Create Table, Python MySQL – Insert into Table, Python MySQL – Select Query, Python MySQL – Update Query, Python MySQL – Delete Query, Python NoSQL Database, Python Datetime, Data Wrangling in Python, Pandas Group by: Summarising, Aggregating, and Grouping data, What is Unstructured Data?, Label Encoding of datasets, One Hot Encoding of datasets</p>			
Module 4			10 Hours
<p>Statistics : Measures of Central Tendency, Statistics with Python, Measuring Variance, Normal Distribution, Binomial Distribution, Poisson Discrete Distribution, Bernoulli Distribution, P-value, Exploring Correlation in Python, Create a correlation Matrix using Python, Pearson’s Chi-Square Test</p>			
Text Books:			
<ol style="list-style-type: none"> 1. Python for Data Analysis, Wes McKinney, 2nd edition, O’Reilly Media, ISBN: 978-1-491-95766-0, 2018. 			

2. Python Programming and SQL, Mark Reed
3. Introduction to Data Science: Practical Approach with R and Python, B Uma Maheshwari , R. Sujatha

Reference Books:

1. Introduction to Python for Data Science:Paul J. Deitel, Harvey M. Deitel, Harvey Deite

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc23_cs99/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓				✓									
CO2		✓			✓								✓	
CO3			✓		✓								✓	
CO4									✓	✓		✓		

Course Title	QUANTUM COMPUTING		
Course Code	22CB407C	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40
<p>Course Objective: The primary course objective is to equip students with a strong foundation in the mathematical prerequisites for quantum computation, including proficiency in linear algebra and complex numbers, wave functions, quantum superposition, and entanglement, essential for quantum computing applications.</p> <p>Course Outcomes (COs): Upon completion of the course, students shall be able to:</p>			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Discuss the fundamental principles of quantum mechanics, including wave functions, eigenvalues, and quantum superposition, as well as the mathematical tools of linear algebra and complex numbers used in quantum computation.	-	-
2.	Apply the fundamental principles of quantum mechanics and implement quantum circuits and quantum logic	1	1
3.	Analyse quantum algorithms and circuits built on actual quantum computers or simulators	2	-
4.	Collaborate effectively in teams and demonstrate the applications of quantum computers in real life	9,10	-
Course Contents:			
Module 1			10 Hours
<p>Mathematical Prerequisites for Quantum Computations: Representing and operating quantum systems by using mathematical methods. Linear algebra. Matrix operations; addition, multiplication, transpose of matrix, etc. Density matrix. Unitary matrices. Fundamental operations of complex numbers; addition, multiplication, conjugate of a complex number, Argand diagram etc.</p>			
Module 2			10 Hours
<p>Quantum Physics for Quantum Computations Wave function, Ortho-normalization condition of wave function, Operators, Eigen values and Eigen functions. Dirac bracket notation. Ket state and Hilbert space. Failure of Moore's Law. Principles of quantum mechanics for quantum computing; Quantum superposition and Quantum entanglement principles. EPR paradox and Bell's inequality. Additionally, Wave-particle dualism, Heisenberg Uncertainty Principle, Quantum tunnelling, etc. All the postulates of Quantum mechanics. Quantum realm and nonlocality. Quantum teleportation. Predictions of Quantum superposition states of quantum systems.</p>			
Module 3			10 Hours
<p>Linear algebra for Quantum Computations Difference between Classical and Quantum computers. Power of quantum computers; Reversible computation, parallel computation, exponential growth of computational power etc. Qubits, pure and mixed states of a qubit. Bloch sphere and single qubit quantum logic gates; Hadamard gate, Pauli's gates (X), Y) and Z), phase gate and other gate. Different operations of quantum logic gates on single qubit by the means of Bra-Ket and matrix operations. Multi qubit systems: Logic gates – CNOT gate, Swap gate, CZ gate, C phase gate, Taffoli gate, Fredkin (controlled swap) gate</p>			
Module 4			10 Hours
<p>Approaches of Quantum Computers Architectures Physical realization of Quantum superposition and quantum entanglement; Superconducting Qubits, Trapped Ion Qubits, Topological Qubits, Photonic Qubits, Nuclear Magnetic Resonance (NMR), Silicon Spin Qubits, Adiabatic Quantum Computers, Hybrid Quantum-Classical Systems. Quantum simulators; IBM Qiskit. Quantum error correction.</p>			
Text Books:			
<ol style="list-style-type: none"> 1. Quantum computation and quantum information- Michael A. Nielsen, Isaac L. Chuang - Cambridge University Press, 2004. 2. Modern Quantum Mechanics, J. J. Sakurai and Jim Napolitano. 3. Quantum Computing: From Linear Algebra to Physical Realizations, Mikio Nakahara and Tetsuo Ohmi. 			

Reference Books:

1. Quantum Algorithms by Ronald de Wolf, first edition.
2. Quantum Hardware by Merzbacher and Styer, first edition.
3. Quantum Information Theory and the Foundations of Quantum Mechanics by Christopher G. Timpson, first edition.
4. Quantum Error Correction by Daniel A. Lidar and Todd A. Brun, first edition.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview

Activity

1. Apply single & multiple quantum logic gates in an actual quantum computer and interpret its result.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	✓												✓	
CO3		✓												
CO4									✓	✓				

Course Title	HUMAN RESOURCE MANAGEMENT		
Course Code	22CB407D	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50 (30-20-0)
Course Objective: To introduce the student to the theory, concepts, and business application of human resources research, data, metrics, systems, analyses, and reporting.			
Course Outcomes (COs): At the end of course, student will be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1	solve case studies on Workplace Ethics Discussion on “How to have/ evaluate the performance of the students	1	-
2	visit organizations and find out the problems and causes for unethical behavior at Workplace.	1	-
3	Identify the important HR metrics used in manufacturing companies..	2,5	-
4	collect manpower data of your institute and prepare HR Dashboards.	2,4	-
Course Contents:			
Module 1			10Hours
HR Analytics in perspective: Role of Analytics, Defining HR Analytics, HR Analytics: The Third Wave for HR value creation, HR Measurement journey in tune with HR maturity journey Understanding the organizational system (Lean) , Locating the HR challenge in the system , Valuing HR Analytics in the organizational system, Typical problems (working session)			
HRA Framework: Current approaches to measuring HR and reporting value from HR contributions, Strategic HR Metrics versus Benchmarking, HR Scorecards & Workforce Scorecards and how they are different from HR Analytics, HR Maturity Framework: From level 1 to level 5, HR Analytics Frameworks: (a) LAMP framework; (b) HCM: 21 Framework and (c) Talent ship Framework, 5 overarching components of an effective Analytics framework.			
Module 2			10 Hours
Basics of HR Analytics: what is Analytics, Evolution, Analytical capabilities, Analytic value chain, Analytical Model, Typical application of HR analytics.			
Predictive Analytics: Steps involved in predictive analytics: Determine key performance indicator, analyse and report data, interpreting the results and predicting the future. Metrics and Regression analysis and Causation.			
Module 3			10 Hours
Human Resources Development –Training and Development Methods - Design & Evaluation of T&D Programmes - Career Development - Promotions and Transfers - Personnel Empowerment including Delegation - Retirement and Other Separation Processes. Financial Compensation- - Productivity and Morale - Principal Compensation Issues & Management - Job Evaluation - Productivity, Employee Morale and Motivation - Stress Management - Quality of Work Life.			
Module 4			10 Hours
HR Matrices : Defining metrics, Demographics, data sources and requirements, Types of data, tying data sets together, Difficulties in obtaining data, ethics of measurement and evaluation. Human capital analytics continuum.			
HR Dashboards Statistical software used for HR analytics: MS-Excel, IBM- SPSS, IBMAMOS, SAS, and R programming and data visualization tools such as Tableau, Plotly, Click view and Fusion Charts.			
Text Books :			
2. Moore, McCabe, Duckworth, and Alwan. The Practice of Business Statistics: Using Data for			

Course Title		UNIVERSAL HUMAN VALUES	
Course Code	22UHK408	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	24 Hrs.
<p>Course Objective: The course aims at the development of the value education by the right understanding through the process of self-exploration (about themselves), family, society and nature/existence. Strengthening of self-reflection by development of commitment and courage to act are presented as the prime focus throughout the course towards qualitative transformation in the life of the student.</p> <p>Course Outcomes (COs): Upon completion of the course, students shall be able to:</p>			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Start exploring themselves, get comfortable with each other and with the teacher and they start appreciating the need and relevance for the course. Also they are able to note that the natural acceptance (intention) is always for living in harmony.	6, 7, 8, 9, 12	-
2.	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.	6, 7, 8, 9, 12	-
3.	Present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them	6, 7, 8, 9, 12	-
Course Contents:			
Module 1			07 Hours
<p>Introduction to Value Education: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations</p>			
Module 2			07 Hours
<p>Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self Lecture, Understanding Harmony in the Self Tutorial, Harmony of the Self with the Body to ensure self-regulation and Health.</p>			
Module 3			07 Hours
<p>Harmony in the Family, Nature and Existence: 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, Understanding Harmony in the Society, Vision for the Universal Human Order.</p> <p>Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.</p>			
Module 4			07 Hours
<p>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.</p>			
<p>Self-Learning Activities-</p> <ol style="list-style-type: none"> 1. Sharing about One self and Exploring Natural Acceptance 2. Exploring Harmony of Self with the Body 3. Exploring the Feeling of Respect 4. Exploring the Four Orders of Nature Lecture and Exploring Co-existence in Existence 5. Exploring Humanistic Models in Education, Exploring Steps of Transition towards Universal Human 			

Order**Text Books:**

1. The Textbook: A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. The Teacher's 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:

1. Jeevan Vidya:EkParichaya, ANagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N.Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5. Small is Beautiful-E.F Schumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence-JCKumarappa
8. Bharat Mein Angreji Raj–Pandit Sunderlal.
9. Redis covering India-by Dharampal
10. Hind Swarajor Indian Home Rule-by Mohandas K. Gandhi.
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland(English)
13. Gandhi-Romain Rolland(English)

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						✓	✓	✓	✓			✓		
CO2						✓	✓	✓	✓			✓		
CO3						✓	✓	✓	✓			✓		

Course Title	Biology for Engineers		
Course Code	22BOK409	(L-T-P)C	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2
SEE	50 Marks	Total Hours	28
Course Objective: Realization of relation between Natural Engineering and man-made Engineering.			
Course outcomes: At the end of course, student will be able to:			
No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	To familiarize engineering students with basic biological concepts	-	-
2.	Apply the interdisciplinary vision of biology to engineering	1	-
3.	Analyze how biological systems can be designed and engineered to substitute natural system	2	-
4.	To develop biological models using AI tools	5	-
Course Contents:			
MODULE – 1			6 Hrs.
Introduction to Human Anatomy: Overview of human anatomy, Structural organization of the human body- cardiovascular system, endocrine system, digestive system, respiratory system, excretory system, lymphatic system, nervous system, muscular system and skeletal system.			
MODULE – 2			8 Hrs.
Bioinspired Engineering based on human physiology: Circulatory system (artificial heart, pacemaker, stents), Nervous system (Artificial neural network).			
MODULE -3			8 Hrs.
Bioinspired Algorithms and Applications: Genetic algorithm, Gene expression modelling. Parallel Genetic Programming: Methodology, History, and Application to Real-Life Problems. Dynamic Updating DNA Computing Algorithms. Beehive: New Ideas for Developing Routing Algorithms Inspired by Honey Bee Behaviour.			
MODULE -4			6 Hrs.
Artificial Intelligence and Biology: Applications of AI in medical imaging, neural engineering, systems biology, microbiome and data mining.			
Text Books:			
<ol style="list-style-type: none"> 1. Bioinspired Engineering, NY: Momentum press, Jenkins, C.H. 2012 ISBN: 97816066502259 2. A Practical Guide to Bio-inspired Design, HashemiFarzaneh, Helena, Lindemann, Udo, Springer2019, ISBN 978-3-662-57683-0 			
Reference Books:			
<ol style="list-style-type: none"> 1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022 2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012. 3. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014. 			
MOOCS			
<ol style="list-style-type: none"> 1. https://onlinecourses.nptel.ac.in/noc19_ge31/preview 			

