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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

IV Semester

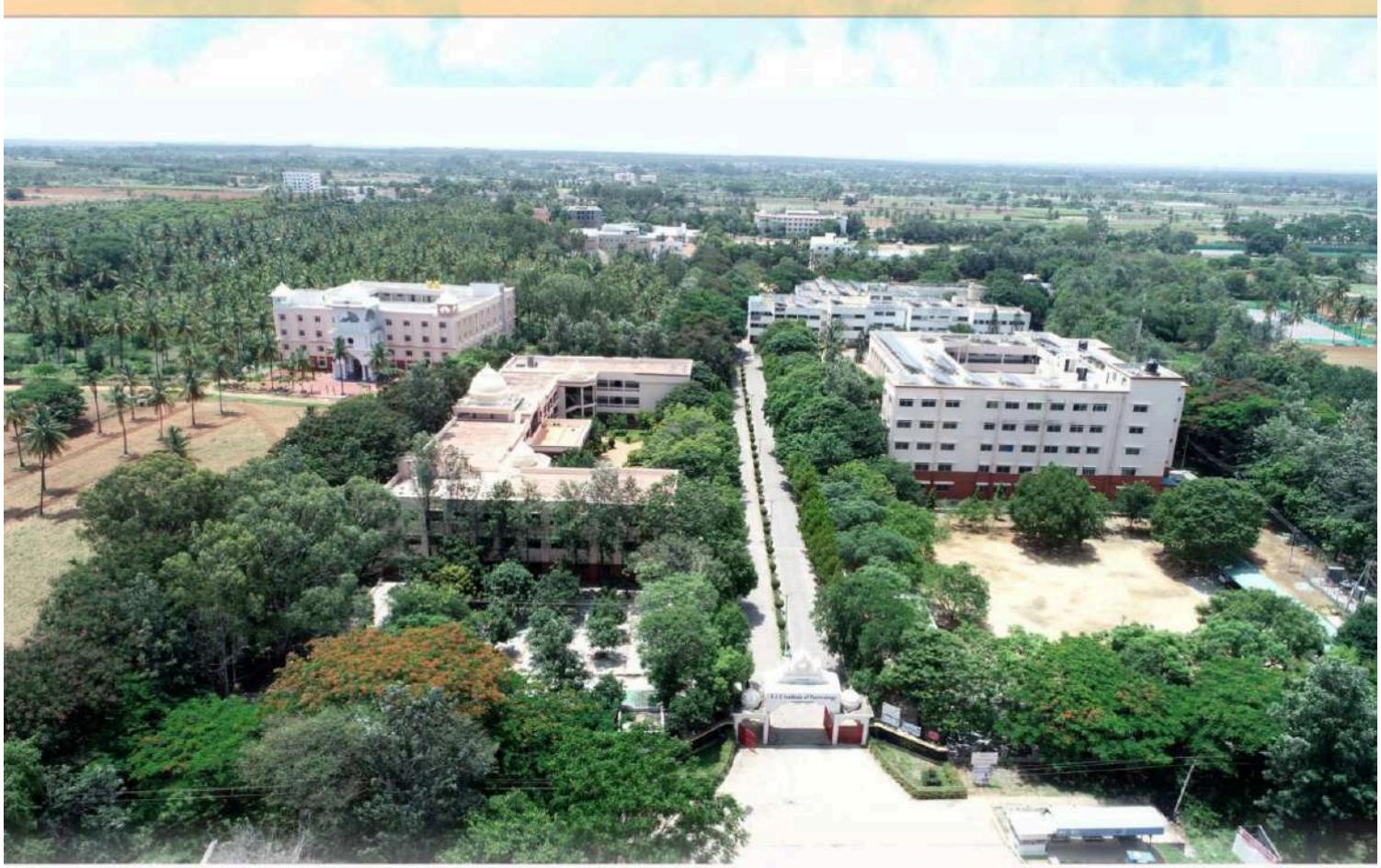
Scheme & Syllabus of B.E. Programme

Artificial Intelligence and Data Science

(2025 Scheme)

Core Values

Spiritual, **J**udicious, **C**ommitment, **I**ntegrity, **T**rustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

A+ NAAC

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating



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Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

(An Autonomus Institute Under VTU Belagavi & Approved by AICTE, New Delhi)

Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF (151-300), QS-I Gauge GOLD Rated

Post Box #20, B.B. Road, Chikkaballapur - 562 101, Karnataka

B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations-2025

Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS) (Effective from the academic year 2025-26)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching and Learning Scheme					Examination				Credits
					CI		LI	TW & SL	Total Hours per sem	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
1	ASC	1BMATS401	Probability, Statistics and Linear Algebra	TD/PSB: Maths	42	0	0	48	90	3	50	50	100	3
2	IPCC	1BCS402	Database Management Systems	TD/PSB: CS Allied	42	0	28	50	120	3	50	50	100	4
3	PCC	1BCS403	Algorithm Design Techniques	TD/PSB: CS Allied	42	28	0	50	120	3	50	50	100	4
4	IPCC	1BCI404	Artificial Intelligence	TD/PSB: CS Allied	42	0	28	50	120	3	50	50	100	4
5	PCCL	1BCSL405	Algorithms Laboratory	TD/PSB: CS Allied	0	0	28	02	30	3	50	50	100	1
6	AEC	1BXXL406x	Ability Enhancement Course Laboratory**	TD/PSB: CS Allied	0	0	28	02	30	2	50	50	100	1
7	BSC	1BBI407	Biology for Engineers (CS and EC Stream)	TD / PSB:	14	0	0	16	30	3	50	50	100	1
8	SDC	1BEP408	Environmental Science Project	TD/PSB:	0	0	0	30	30	2	50	50	100	1
9	HSSM	1BMP409	Metaphysical Science	TD/PSB:	14	0	0	16	30	2	50	50	100	1
10	NCMC	1BNS410	National Service Scheme	Campus: NSS coordinator	0	0	0	28	28	--	100	---	100	PP
		1BPE410	Physical Education	Physical Education Director										
		1BYO410	Yoga	Yoga Teacher										
		1BMU410	Music	Music Teacher										
		1BNC410	National Cadet Corps - II	NCC coordinator										
11	NCMC	1BCE411	Competency Enhancement Course-2	CDCAC	14	0	0	14	28	--	100	---	100	PP
12	NCMC	1BMATDIP412	Additional Mathematics – II	TD/PSB -Maths Dept.	14	0	0	14	28	--	100	--	100	PP
				Total							**750**	**450**	**1200**	**20**

Ability Enhancement Course (Laboratory) 1BXXL406x			
1BADL406A	MERN	1BCSL406C	JavaScript and jQuery
1BCIL406B	Data Analytics with Power BI and Tableau	1BADL406D	MongoDB

Semester: IV					
Probability, Statistics and Linear Algebra					
Course Code	:	1BMATS401	**Credits**	:	3
Hours/Semester (L:T:P:SL)	:	42:0:0:48	**CIE**	:	50 Marks
Total Hours	:	90	**SEE**	:	50 Marks
Course Type	:	ASC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Basic Probability and Statistics.
Knowledge on Fundamental Concepts	Basic Probability distributions and linear Algebra.
Knowledge on Connected Tools (If any)	Proficiency in programming using R and Python for feature selection and data visualization.

Course Learning Objectives: This course will enable the students to	
CLO1	Investigate the association between attributes and the correlation between two variables.
CLO2	Describe the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and real-life situations.
CLO3	Demonstrate the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
CLO4	Interpret the concepts of eigenvalues, eigenvectors, and the Cayley-Hamilton theorem to solve matrix-related problems.
CLO5	Implement optimization techniques using diagonalization, SVD.

Module – 1	**08 Hrs.**
Curve fitting and Statistical Analysis: Curve fitting by method of least squares: $y = ax+b$, $y = ax^2 +bx+c$ and $y= ax^b$, Correlation–Karl Pearson's coefficient of correlation, Rank correlation and Regression analysis – lines of regression (without proof)- problems.	
Module – 2	**08 Hrs.**
Probability Distributions: Random Variables (Discrete and Continuous). Probability mass and density functions. Mathematical expectation, Mean and variance. Discrete probability distributions: Binomial, Poisson, and Normal distributions (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.	
Module – 3	**08 Hrs.**
Sampling Theory: Introduction, sampling distribution, standard error, Type-I and Type-II errors. Testing of hypothesis, levels of significance, confidence limits, test of significance for large samples for mean and proportions. Test of significance for small samples - Students 't' distribution, Chi-square distribution as a test of goodness of fit.	

Module – 4	08 Hrs.
Eigenvalues and Eigenvectors: Introduction, Applications of Cayley-Hamilton Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.	
Module – 5	**08 Hrs.**
Optimization Techniques in Linear Algebra: Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction.	

Topics for Self-learning		
Module – 1	**Applications:**	Multiple regression in performance tuning and optimization in Software engineering.
	Self-Study:	Curve fitting by method of least squares: $y= ae^{bx}$, ab^X.
Module – 2	**Applications:**	Analyze the performance of the algorithms.
	Self-Study:	Exponential distribution.
Module – 3	**Applications:**	Data analysis and Cryptography.
	Self-Study:	Sampling of attributes, F-distribution.
Module – 4	**Applications:**	Discrete dynamical systems
	Self-Study:	Complex Eigen values
Module – 5	**Applications:**	Applications to the linear models, PCA
	Self-Study:	Complex Eigen values

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze data using correlation and regression techniques by using the principles of least squares to perform curve fitting.
CO2	Evaluate probability distributions and random variable concepts to model and simulate uncertainties in engineering systems such as atmospheric turbulence.
CO3	Analyze statistical inference techniques including hypothesis testing, error analysis.
CO4	Apply eigenvalues, eigenvectors, and the Cayley–Hamilton theorem for solving matrix-related problems.
CO5	Evaluate quadratic forms and use SVD and PCA for optimization and dimensionality reduction in real-world applications.

Textbooks	
1	"A First Course in Probability", Sheldon Ross (10th edition) 2019, Pearson College Div Publication, ISBN-13: 978-0134753119. Chapters: Ch 4, 5, 24, 25.
2	"Probability and Statistics for Engineers and Scientists" – Ronald E. Walpole et al. 9th edition, 2022, Pearson Publication, **ISBN-13:** 978-0321629111. Chapters: Ch 1, 6, 8, 10, 11, 12.
3	"Linear Algebra and its applications", David C. Lay, Steven R. Lay, Judi J Mc. Donald, Pearson Education Publication, 6th Edition, 2021, ISBN-13: 978-1292351216. Chapters: Ch 5, 6, 7.

Reference Books	
1	"Engineering Mathematics", Srimanta Pal & Subodh C. Bhunia, Oxford University Press, 3rd Ed., 2016, ISBN: 978-0198070894.
2	"Advanced Engineering Mathematics", C. Ray Wylie, Louis C. Barrett, McGraw – Hill Book Co., New York, 6th Ed., 2017, ISBN: 978-0071135436.
3	"Higher Engineering Mathematics", H.K. Dass and Er. Rajnish Verma, S. Chand Publication, 3rd Ed., 2014, ISBN: 978-8121938907.
4	"A Textbook of Engineering Mathematics", N.P Bali and Manish Goyal, Laxmi Publications, 10th Ed., 2022, ISBN-13: 978-8131808320.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses.php?disciplineID=111
2	http://www.class-central.com/subject/math(MOOCs)

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2						2	
CO2	3	3	3	2						2	
CO3	3	3	3	2						2	
CO4	3	2	3	2						1	
CO5	3	2	2	2						2	

	CSE		ISE		CSD		AI&ML		AI&DS		EC	
	PSO1	PSO2	PSO1	PSO2	PSO1	PSO2	PSO1	PSO2	PSO1	PSO2	PSO1	PSO2
CO1	1			1		1		1		1		1
CO2	1			1		1		1		1		1
CO3	1			1		1		1		1		1
CO4	1			1		1		1		1		1
CO5	1			1		1		1		1		1

Semester: IV					
Database Management Systems					
Course Code	**:**	1BCS402	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:0:28:50	**CIE**	**:**	50 Marks
Total Hours	**:**	120	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Problem Solving Through Programming, Data Structures, Discrete Mathematics, Operating Systems.
Knowledge on Fundamental Concepts	Understanding of sets, relations and functions, logic, data structures, and basics of concurrency and process management.
Knowledge on Connected Tools (If any)	Oracle AI Database 23c, MySQL, MongoDB.

Course Learning Objectives: This course will enable the students to	
CLO1	Articulate fundamental database concepts, technologies, and practices.
CLO2	Design relational models, constraints and apply relational algebra operations to formulate queries
CLO3	Implement relational database solutions using SQL commands, constraints, views, triggers and assertions.
CLO4	Analyze relational schemas using functional dependencies and normalization techniques to improve database design.
CLO5	Demonstrate database transaction, concurrency, storage, access, and NoSQL technologies for effective data management.

Module – 1	**08 Hrs**
Databases and Database Users: Introduction: An example, characteristics of the database approach, actors on the scene, workers behind the scene, advantages of using the DBMS approach, a brief history of database Applications, when Not to use a DBMS. **Database System – Concepts and Architecture**: 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 for the COMPANY Database, ER Diagrams, Naming Conventions and Design Issues.	
Module – 2	**08 Hrs**
Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational Algebra**: Unary relational operations: Select, Project, Relational Algebra Operations from Set Theory, Binary relational operations: join and division, additional relational operations (aggregate, grouping, Outer Join and Union Operations), Examples of Queries in relational algebra.	

Mapping Conceptual Design into a Logical Design: Relational database design using ER to Relational Mapping.	
Module – 3	**08 Hrs**
Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE and UPDATE Statements in SQL, Additional features in SQL **More SQL**: More complex SQL retrieval queries, Specifying constraints as assertions and actions as triggers, Views in SQL, Schema Change Statements.	
Module – 4	**08 Hrs**
Basics of Functional Dependencies: Informal Design Guidelines for Relation Schemas, Functional Dependencies. **Normalization for Relational Database**: 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, Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover.	
Module – 5	**08 Hrs**
Transaction Processing Concept: Introduction to transaction processing, transaction and system concepts, desirable properties of transactions. **Concurrency Control**: Two phase locking techniques, Concurrency control based on Timestamp ordering. **NOSQL Databases and Big Data Storage Systems**: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.	

Practical component Design, develop, and Implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under LINUX/Windows environment.	
Module – 3	**1.Consider the EMPLOYEE table with the following attributes and domains:** **EMPLOYEE (EMPNO NUMBER(5), ENAME VARCHAR2(50), JOB VARCHAR2(30), MGR NUMBER(5), SAL NUMBER(10,2))** Write SQL queries to perform the following operations: a. Create a user and grant all privileges to that user. b. Create the EMPLOYEE table using the above attributes and insert at least 5 records. c. Add a new column COMMISSION NUMBER(10,2) to the EMPLOYEE table. d. Alter the EMPLOYEE table to add a PRIMARY KEY constraint to EMPNO. e. Add a NOT NULL constraint to the ENAME column and verify it by trying to insert a record with NULL to the ENAME attribute. f. Update the JOB designation of an employee whose EMPNO = 102. g. Rename the column MGR to MANAGER_NO using the ALTER command. h. Delete the employee whose EMPNO = 105. i. Insert any three records into the EMPLOYEE table, verify the inserted records using a SELECT statement, and then perform a ROLLBACK operation to undo the changes. Write an SQL statement to DROP the EMPLOYEE table from the database.
Module – 3	**2.Consider the PLAYER table with the following attributes and domains:** **PLAYER (PLAYERID INT, PLAYERNAME VARCHAR(50), TEAM_NAME VARCHAR(30), ROLE VARCHAR(20), RUNS INT, WICKETS INT, NO_MATCHES INT)**

	Write SQL queries to perform the following operations: a. Create the PLAYER table using the above attributes and insert at least 5 records. b. Display all player details from the PLAYER table. c. Retrieve the distinct TEAM_NAME values from the PLAYER table. d. Display the PLAYERNAME of players whose names start with 'A' using the LIKE operator. e. Find the total number of RUNS scored by all players using the SUM aggregate function. f. Find the average RUNS scored by players in each TEAM_NAME using GROUP BY. g. Display the maximum RUNS scored and the minimum number of WICKETS taken by players in each TEAM_NAME using the GROUP BY clause. h. Find the total RUNS scored by each TEAM_NAME and display them in descending order using ORDER BY. i. Find the average RUNS for each ROLE and display only those ROLE values whose average RUNS are greater than 3000 using HAVING. j. Find the number of players in each TEAM_NAME using COUNT and GROUP BY. k. Create a VIEW that displays players who have played more than 100 matches (NO_MATCHES > 100).
Module – 3	**3.Consider a relational database schema for a SAILORS database as given below:** **SAILORS (SID INTEGER, SNAME STRING, RATING INTEGER, AGE REAL)** **BOATS (BID INTEGER, BNAME STRING, COLOR STRING)** **RESERVES (SID INTEGER, BID INTEGER, DAY DATE)** Using the above schema, perform the following operations: a. Create the above tables with appropriate PRIMARY KEYS and FOREIGN KEYS and insert at least 5 records into each table. b. Retrieve the SNAME of sailors who have reserved a RED boat, listed in ascending order of AGE. c. Retrieve the SNAME of sailors who have reserved boat number 103. d. Calculate the average AGE of sailors for each RATING level, considering only those RATING levels that have at least two sailors. e. Retrieve the SNAME of sailors who have reserved a RED or GREEN boat.
Module – 3	**4.Create a row-level trigger for the CUSTOMERS table** that fires on INSERT, UPDATE, or DELETE operations performed on the CUSTOMERS table. The trigger should display the difference between the OLD and NEW SALARY values wherever applicable. **CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY**)
Module – 3	**5.Consider the schema for STUDENT DATABASE:** **STUDENT (USN, NAME, BRANCH, PERCENTAGE)** **FACULTY (FID, FNAME, DEPARTMENT, DESIGNATION, SALARY)** **COURSE (CID, CNAME, FID)** **ENROLL (CID, USN, GRADE)** Write SQL queries to perform the following operations:

	a. Create the above tables with appropriate PRIMARY KEYS and FOREIGN KEYS and insert at least 5 records into each table. b. Retrieve the NAME of all students enrolled for the course 'CS_54'. c. List all the DEPARTMENT values having an average SALARY of the faculties above 10000. d. List the NAME of the students enrolled for the course 'CS_51' and having GRADE 'B'. e. Retrieve the FNAME of faculty members who are handling more than one course. f. List the NAME of students who have enrolled in more than two courses.
Module 5	6.Install an Open Source NoSQL Data base MangoDB & perform basic CRUD(Create, Read, Update & Delete) operations. Execute MangoDB basic Queries using CRUD operations.
Module 1-5	7.Open Ended Mini Project should be implemented and shall be carried out in a batch of three students. The students will finalize a topic in consultation with the faculty.

Topics for Self learning	
Module – 1	1. Evolution of Databases (Hierarchical, Network, Relational, Cloud Databases)
	2. Cloud Databases and Database as a Service
Module – 2	1. Introduction to Data Modeling Tools
	2. Introduction to Distributed Databases
Module – 3	1. Stored Procedures and Functions
	2. SQL Injection and Database Security
Module – 4	1. Database Denormalization Techniques
	2. Data Redundancy and Data Integrity Issues
Module – 5	1. Blockchain Databases
	2. Big Data Ecosystem (Hadoop, Spark Basics)

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend database concepts, architecture, classifications and design relational schemas from ER diagrams.
CO2	Apply relational model concepts in the design of relational databases.
CO3	Develop database schemas and SQL queries using DDL, DML, constraints, views, triggers and assertions.
CO4	Analyze relational schemas and perform normalization using functional dependency.
CO5	Design reliable database systems using transactions, concurrency control, recovery mechanisms and NoSQL database technologies.

Textbook	
1	"Fundamentals of Database Systems", Elmasri and Navathe, 8th Edition, 2026, Pearson Education, ISBN: 9780138090807 Chapters:1,2,3,5,6,7,8,9,14.15.20,21,22,24

Reference Books	
1	"Database System Concepts", Silberschatz, A., Korth, H. F., & Sudarshan, 7th Edition, 2019 McGraw-Hill, ISBN: 9780078022159.
2	"Database Management Systems", Raghu Ramakrishnan and Johannes Gehrke 7th Edition, 2003, McGraw-Hill ISBN: 9780072465631.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX 4vP2YMIf4Ebh
2	https://www.youtube.com/watch?v=sEaYXwmsLw0&list=PLyqSpQzTE6M-xymXgqewlzcC3U4cdRoSu
3	https://www.w3schools.com/sql/default.asp
4	https://www.tutorialspoint.com/dbms/index.htm
5	https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system- set-1/

CO – PO – PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1						2	2		2	2	2
CO2	3	2						2	2		2	2	2
CO3	2	2	2		3		1	2	2		2	2	2
CO4	2	3	2	2				2	2		2	2	2
CO5	2	3	2	2	3	2	1	2	2	2	2	3	3

Semester: IV					
Algorithm Design Techniques					
Course Code	:	1BCS403	**Credits**	:	4
Hours/Semester (L:T:P:SL)	:	42:28:0:50	**CIE**	:	50 Marks
Total Hours	:	120	**SEE**	:	50 Marks
Course Type	:	PCC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Problem Solving through Programming, Data Structures and Algorithms, Discrete Mathematical Structures and Graph Theory
Knowledge on Fundamental Concepts	Basic programming constructs, Time and space complexity analysis, Recursion and mathematical induction, Linear and non-linear data structures
Knowledge on Connected Tools (If any)	GCC, Turbo C, Code::Blocks, Dev C++, Visual Studio Code

Course Learning Objectives: This course will enable the students to	
CLO1	Explain brute-force and decrease-and-conquer techniques for solving computational problems.
CLO2	Apply divide-and-conquer and dynamic programming methods to sorting, optimization, and string-matching problems.
CLO3	Describe greedy algorithms and network flow techniques used in graph problems and data compression.
CLO4	Implement transform-and-conquer and space-time trade-off techniques to improve algorithm efficiency.
CLO5	Apply backtracking, branch-and-bound, and approximation techniques to solve NP-hard problems.

Module – 1	**08 Hrs**
Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching, Exhaustive Search. **Decrease and Conquer:** Algorithms for Generating Combinatorial Objects, Decrease-by-a-Constant-Factor Algorithms: Binary Search.	
Module – 2	**08 Hrs**
Divide And Conquer: Merge Sort, Quick Sort, Multiplication of large integers. **Dynamic Programming:** Three basic examples, The Knapsack Problem and Memory Functions, Optimal Binary Search Trees, Bellman-ford algorithm, Knuth-Morris-Pratt algorithm	

Module – 3	08 Hrs
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Johnson's algorithm for sparse graphs, Max-Flow: Flow networks, Ford-Fulkerson method, Maximum bipartite matching, Huffman Trees and Codes.	
Module – 4	**08 Hrs**
Transfer and Conquer: Balanced Searched Trees, Heaps and Heap Sort **Space-Time Trade-offs:** Sorting by Counting: Comparison counting sort, Input Enhancement in string matching: Horspool's algorithm, Boyer-Moore algorithms.	
Module – 5	**08 Hrs**
Limitations of Algorithmic Power: Decision Trees, P, NP, and NP-Complete Problems. **Coping with Limitations of Algorithmic Power:** Backtracking, Branch-and-Bound, Approximation algorithms for NP-Hard problems.	

Topics for Self learning	
Module – 1	Analysis and Comparison of Basic Sorting Algorithms
	Applications of Permutations and Combinations in Computing
Module – 2	Longest Common Subsequence (LCS) using Dynamic Programming
	Rabin-Karp String Matching Algorithm
Module – 3	Applications of Minimum Spanning Trees in Network Design
	Huffman Coding for Data Compression
Module – 4	Applications of Maximum Flow in Real-World Networks
	Shortest Path Algorithms in Navigation Systems
Module – 5	Traveling Salesman Problem (TSP)
	Heuristic and Metaheuristic Approaches for NP-Hard Problems

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamental principles of algorithm design techniques and illustrate their applications.
CO2	Analyze a given algorithm and express its time and space complexities in asymptotic notations
CO3	Analyze and apply algorithm design paradigms to solve computational / combinatorial / graph-based / optimization problems.
CO4	Employ graphs to model engineering problems and illustrate graph algorithms and their analysis.
CO5	Analyze algorithmic limitations and apply backtracking, branch-and-bound, or approximation techniques to solve NP-hard problems.

Text Books	
1	Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2022, Pearson, ISBN-13: 978-9332585485 Chapters:3,4,5,7,8,9,11,12
2	Introduction to Algorithms, Thomas H. Cormen ,Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 4th Edition, The MIT Press,2022, ISBN: 978-0262046305. Chapters:24,25,26,32

Reference Books	
1	Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press, ISBN: 978-8173716119
2	Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education), 2nd Edition,2023, Oxford University Press, ISBN: 978-9354977886

Web links and Video Lectures (e – Resources)	
1	Design and Analysis of Algorithms: https://nptel.ac.in/courses/106106131/

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1									1	1	
CO2	2	3										1	
CO3	2	3	3									2	1
CO4	2	2	3	2	1							2	2
CO5	2	3	3	1							1	3	1

Semester: IV					
Artificial Intelligence					
Course Code	:	1BCI404	**Credits**	:	4
Hours/Semester (L:T:P:SL)	:	42:0:28:50	**CIE**	:	50 Marks
Total Hours	:	120	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Data structures, Python
Knowledge on Fundamental Concepts	Linear Algebra, Probability and Statistics
Knowledge on Connected Tools (If any)	Jupyter Notebook

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and gain a historical perspective of AI, Intelligent Agents and its foundations.
CLO2	Finding the solution using uninformed and informed search.
CLO3	Get to know approaches of inference, perception, knowledge representation, and learning.
CLO4	Analyze the knowledge representation language.
CLO5	Develop principles of Artificial Intelligence (AI) to solve real-world problems.

Module – 1	**08 Hrs.**
Artificial Intelligence - Introduction: What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Risks and Benefits of AI. **Artificial Intelligence - Intelligent Agents:** Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	
Module – 2	**08 Hrs.**
Problem-solving – Solving Problems by Searching: Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies.	
Module – 3	**08 Hrs.**
Problem-solving – Solving Problems by Searching: Informed (Heuristic) Search Strategies (Greedy best-first search, A*search), Heuristic Functions. **Knowledge, Reasoning and Planning - Logical Agents:** Knowledge–Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic.	
Module – 4	**08 Hrs.**
Knowledge, Reasoning and Planning - First Order Logic: Representation Revisited, Syntax and Semantics of First Order Logic, Using First Order logic. **Knowledge, Reasoning and Planning - Inference in First Order Logic:** Propositional vs. First Order-Inference, Unification and First Order-Inference, Forward Chaining, Backward Chaining, Resolution.	

Module – 5	08 Hrs.
Uncertain Knowledge and Reasoning - Quantifying Uncertainty: Acting under Uncertainty,Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes'Rule and Its Use, Wumpus World Revisited. **Expert Systems:** Representing and Using Domain Knowledge, Expert System Shells,Explanation, Knowledge Acquisition.	

Practical component	
Module – 1	Implement a vacuum cleaner agent to perform basic cleaning functions.
Module – 2	Implement the Water Jug Problem using Depth First Search Algorithm.
Module – 3	Implement the Missionaries and Cannibals Problem using the Best First Search Algorithm.
	Implement the A* search algorithm to determine the shortest distance between any two nodes in a graph.
	Implement and demonstrate the AO* Search algorithm.
	Implement a solution to the Solve 8-Queens Problem using appropriate assumptions.
	Implement a heuristic based solution to the Travelling Salesman Problem.
	Implement a two player Tic-Tac-Toe game.
Module – 4	Implement and demonstrate problem-solving strategies using Forward Chaining and Backward Chaining.
	Implement and demonstrate the resolution principle on FOPL problems.
	Implement and demonstrate the unification process in first order logic.
	Implement a knowledge base using first order logic statements and prove a given query using forward reasoning.

Topics for Self learning	
Module – 1	Evolution of Artificial Intelligence and Generative AI Applications
	Applications of Intelligent Agents in Real-World Systems
Module – 2	Search Algorithms in Robotics and Autonomous Navigation
	State Space Representation and Problem Formulation in AI
Module – 3	Adversarial Search: Minimax and Alpha-Beta Pruning
	Applications of Heuristic Search in Route Planning and Game AI
Module – 4	Introduction to Logic Programming using Prolog
	Knowledge Graphs and Semantic Web Technologies
Module – 5	Bayesian Networks and Their Applications in Decision Making
	Modern Expert Systems in Healthcare, Finance, and Industry

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the scope, history, and significance of Artificial Intelligence and intelligent agents.
CO2	Apply search strategies to solve well-defined problems in artificial intelligence.
CO3	Develop knowledge-based agents using propositional and first-order logic.

CO4	Analyze reasoning under uncertainty using probabilistic methods.
CO5	Describe the architecture and functioning of expert systems in real-world domains.

	Text Books
1	Artificial Intelligence, Stuart J. Russell and Peter Norvig, 4th Edition, Pearson,2022, ISBN: 978-9356063570. Chapters: Ch 1: 1.1 to 1.3,1.5 & Ch 2: 2.1 to 2.4 Ch 3: 3.1 to 3.4 Ch 3: 3.5(3.5.1,3.5.2),3.6 & Ch 7: 7.1 to 7.4 Ch 8: 8.1 to 8.3 & Ch 9: 9.1 to 9.5 Ch 12:12.1 to 12.5, 12.7
2	Artificial Intelligence, Elaine Rich, Kevin Knight, 3rd Edition, Tata McGraw Hill,2017, ISBN: 978-0070087705. Chapters: Ch 20: 20.1 to 20.4

Reference Books	
1	Artificial Intelligence Structure and strategies for complex problem solving, George F Lugar, 6th Edition, Pearson Education,2021, ISBN: 978-9354493782.
2	Principles of Artificial Intelligence, Nils J. Nilsson, Elsevier, 1993 ISBN: 978-0934613101.

Web links and Video Lectures (e – Resources)	
1	https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
2	https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
3	https://nptel.ac.in/courses/106/105/106105077/

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			1					1		3	
CO2	3	3	2	2	2				1			3	1
CO3	3	3	3	2	3			1	1			3	2
CO4	3	3	2	3	3			1	1			2	3
CO5	2	2	2	2	2	1		2	2	2	1	2	2

Semester: IV					
Algorithms Laboratory					
Course Code	**:**	1BCSL405	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:2	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	PCCL	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Problem Solving through Programming, Data Structures and Algorithms
Knowledge on Fundamental Concepts	Programming Skills
Knowledge on Connected Tools (If any)	Edit plus, GCC, Code blocks, Visual Studio

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply advanced algorithmic techniques.
CLO2	Design and implement efficient algorithms for various problems.
CLO3	Analyze the time and space complexity of algorithms and evaluate their performance for different input cases.
CLO4	Utilize appropriate data structures and optimization strategies to handle large-scale computational problems.
CLO5	Develop problem-solving skills by implementing algorithms for real-world and competitive programming scenarios.

Experiments	
Sl. No.	**List of problems for which student should Develop C program and execute in the Laboratory**
1.	Sort a given set of N integer elements using the Selection Sort algorithm, analyze its time complexity, and evaluate its performance by executing it for varying input size (N>5000). Record the time taken for each case and plot a graph of time versus input size, where the input data may be generated randomly or read from a file.
2.	Sort a given set of N integer elements using the Quick Sort algorithm, analyze its time complexity, and evaluate its performance by executing it for varying input sizes (N>5000). Record the time taken for each case and plot a graph of time versus input size, where the input data may be generated randomly or read from a file.
3.	Sort a given set of N integer elements using the Merge Sort algorithm, analyze its time complexity, and evaluate its performance by executing the algorithm for varying input sizes (N>5000). Record the time taken for each case and plot a graph of time versus input size, where the input data may be generated randomly or read from a file.
4.	Solve the 0/1 Knapsack problem using a dynamic programming approach to determine the maximum achievable value within a given capacity constraint.

5.	Compute the shortest path distances from a given source vertex to all other vertices in a weighted graph using the Bellman–Ford algorithm, and detect any negative-weight cycles reachable from the source.
6.	Perform pattern matching in a given text using the Knuth–Morris–Pratt (KMP) algorithm by preprocessing the pattern to construct the Longest Proper Prefix which is also Suffix (LPS) array, and efficiently identify all occurrences of the pattern in linear time.
7.	Find the Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
8.	Find the Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
9.	Determine the shortest paths from a given source vertex to all other vertices in a weighted connected graph using Dijkstra's algorithm.
10.	Compute the maximum flow from a source vertex to a sink vertex in a flow network using the Ford–Fulkerson algorithm, ensuring that capacity constraints and flow conservation are satisfied.
11.	Find all subsets of a given set $S = \{s_1, s_2, \dots, s_n\}$ of positive integers whose sum equals a specified target value D.
12.	Solve the N-Queens problem using a backtracking approach to place N queens on a $N \times N$chessboard such that no two queens attack each other, and generate all possible valid configurations.

Open Ended Experiments	
1	Comparative Performance Analysis of Selection Sort, Quick Sort, and Merge Sort for varying input sizes.
2	Performance Comparison of Bellman-Ford and Dijkstra's Algorithms on different graph structures.
3	Evaluation of String Matching Algorithms using KMP and other pattern matching techniques on large datasets.
4	Design and Optimization of Real-World Networks using Prim's and Kruskal's Minimum Spanning Tree algorithms.
5	Maximum Flow Analysis in Transportation or Communication Networks using the Ford-Fulkerson algorithm.
6	Scalability Study of Backtracking Algorithms through N-Queens and Subset Sum problems for different input sizes.

Course Outcomes: After completing the course, the students will be able to	
CO1	Design and implement algorithms to solve computational problems using appropriate techniques.
CO2	Apply suitable data structures and algorithmic strategies for efficient problem solving.
CO3	Analyze the time and space complexity of algorithms and evaluate their performance.
CO4	Develop optimized solutions by selecting appropriate approaches for various problem scenarios.
CO5	Demonstrate programming skills to solve real-world problems and validate results effectively.

Text Books	
1	Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2022, Pearson, ISBN-13: 978-9332585485 Chapters:3,4,5,7,8,9,11,12
2	Introduction to Algorithms, Thomas H. Cormen ,Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 4th Edition, The MIT Press,2022, ISBN: 978-0262046305. Chapters:24,25,26,32

Reference Books	
1	Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press, ISBN: 978-8173716119
2	Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education), 2nd Edition,2023, Oxford University Press, ISBN: 978-9354977886

Web links and Video Lectures (e – Resources)	
1	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
2	https://nptel.ac.in/courses/106/105/106105171/
3	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
4	https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
5	https://nptel.ac.in/courses/106/102/106102064/

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2							3	2
CO2	3	3	2	2								3	2
CO3	3	3		3								2	1
CO4	3	3	3	2								3	2
CO5	3	2	2	2	3	1	1	1	2	2		3	3

Semester: IV					
MERN					
Course Code	:	1BADL406A	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:28:2	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Data Structure.
Knowledge on Fundamental Concepts	Object-Oriented Programming language.
Knowledge on Connected Tools (If any)	MongoDB Compass, Postman, Visual Studio.

Course Learning Objectives: This course will enable the students to	
CLO1	Identify the key web development languages and tools used in building dynamic web applications
CLO2	Develop server-side web applications using Node.js and Express.js to handle client request.
CLO3	Design and implement scalable front-end applications using React.js.
CLO4	Analyze the interaction between client requests, APIs, and routing in web-based systems.
CLO5	Manage data using MongoDB and integrate front-end and back-end technologies to develop full-stack web applications.

Experiments	
Sl. No.	**List of problems for which student should Develop program and execute in the Laboratory**
1.	Install the MongoDB driver for Node.js. Create a Node.js script to connect to the shop database. Implement insert, find, update, and delete operations using the Node.js MongoDB driver. Define a product schema using Mongoose. Insert data into the products collection using Mongoose.
2.	Using MongoDB, create a collection called transactions in database usermanaged (drop if it already exists) and bulk load the data from a json file, transactions. json b. Upsert the record from the new file called transactions upsert.json in MongoDB.
3.	Query MongoDB with Conditions: [Create appropriate collection with necessary documents to answer the query] a. Find any record where Name is Somu b. Find any record where total payment amount (Payment. Total) is 600. c. Find any record where price (Transaction.price) is between 300 to 500. d. Calculate the total transaction amount by adding up Payment. Total in all records. By using find and limit.
4.	Develop a program that extracts and validates cookie information from a request header.

5.	Write node.js program to print the car object properties, delete the second property and get length of the object.
6.	Implement all CRUD operations on a File System using Node JS
7.	Develop two routes: find_prime_100 which prints prime numbers less than 100 using Express JS routing mechanism
8.	Develop two routes: find_cube_100 which prints cubes less than 100 using Express JS routing mechanism
9.	Develop a React code to build a simple search filter functionality to display a filtered list based on the search query entered by the user.
10.	Create a REST API. Implement endpoints for a Product resource: GET: Returns a list of products. POST: Adds a new product. GET /:id: Returns details of a specific product. PUT /:id: Updates an existing product.

Open Ended Experiments	
1	Develop a Node.js application to read student details such as USN, Name, Semester, and Year of Admission, and store them in a MongoDB database. Given a partial student name as input, retrieve and display all matching student records from the MongoDB collection
2	Create a component Counter with A state variable count initialized to 0. Create Buttons to increment and decrement the count. Simulate fetching initial data for the Counter component using useEffect (functional component) or component DidMount (class component). Extend the Counter component to Double the count value when a button is clicked. Reset the count to 0 using another button.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the fundamentals of MongoDB, including data modeling, CRUD operations, and query processing, to develop solutions for real-world problems.
CO2	Describe how Express.js routing is used to handle client requests in a web application.
CO3	Analyze the factors that contribute to the scalability and efficiency of RESTful APIs developed using Node.js
CO4	Show how React components, state, props, and JSX work together to build modern web applications
CO5	Construct front-end applications using React.js and integrate them with RESTful APIs to provide complete web solutions.

Text Books	
1	Eddy Wilson Iriarte Koroliova, MERN Quick Start Guide, Packt Publishing.
2	Vasan Subramanian Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress; 1st ed. Edition.

Reference Books	
1	"MongoDB: The Definitive Guide", Kristina chodorow, 2nd ed O'REILLY, 2013.
2	"MongoDB in Action" by KYLE BANKER et. al. 2nd ed, Manning publication, 2016

Web links and Video Lectures (e – Resources)	
1	http://geeksforgeeks.org/mern/understand-mern-stack/
2	https://blog.logrocket.com/mern-stack-tutorial/
3	https://www.w3resource.com/mongodb-exercises/

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2							2	3
CO2	2	2	3	1	3				1			1	1
CO3	2	3	3	2	3				1			2	2
CO4	2	2	2	2	3							1	1
CO5	2	3	3	2	3							2	2

Semester: IV					
Data Analytics with Power BI and Tableau					
Course Code	:	1BCIL406B	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:28:02	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Probability Statistics and Linear Algebra
Knowledge on Fundamental Concepts	Basic concepts of data visualization (charts, graphs, dashboards)
Knowledge on Connected Tools	Basic knowledge of Microsoft Excel, Understanding of CSV file handling and data import/export

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply advanced data visualization concepts using modern BI tools.
CLO2	Perform data cleaning, transformation, and preparation using real-world datasets.
CLO3	Design and develop interactive dashboards for domain-specific applications.
CLO4	Analyze data using advanced visualization techniques to derive meaningful insights.
CLO5	Communicate analytical findings effectively through visual storytelling and reports.

Sl.NO	**Part A - Experiments**
1	Analysis of Global Superstore Dataset: i) Create a Sankey Diagram (Tableau) or Decomposition Tree (Power BI) to visualize order flow using the *Global Superstore Dataset (CSV)*. ii) Create Dual Axis Maps to display shipping regions and delivery locations. iii) Analyze shipping delays using order date and ship date. iv) Create a bar chart to compare sales and profit across regions. v) Develop a calculated field to identify high-delay states. vi) Create KPI indicators for sales, profit, and delivery performance. vii) Build an interactive dashboard.
2	Analysis of Telco Customer Churn Dataset: i) Create a Cohort Analysis heat map to visualize customer retention. ii) Build a line chart to show churn trends over time. iii) Implement What-if Parameters to analyze impact of monthly charges on churn. iv) Create a pie chart to show churn distribution across contract types. v) Create a scatter plot for tenure vs monthly charges. vi) Develop calculated fields to identify "at-risk" customers. vii) Build an interactive dashboard.
3	**Analysis of House Prices Dataset:** i) Create a Box-and-Whisker Plot to analyze sale price distribution. ii) Identify outliers in property pricing. iii) Create a bar chart to compare prices across neighborhoods. iv) Use Z-score calculations to identify undervalued properties.

	v) Create a line chart to show price trends over time. vi) Develop a heat map for location-based pricing insights. vii) Build an interactive dashboard.
4	Analysis of Twitter Sentiment Analysis Dataset: i) Create a Word Cloud to visualize most frequent words. ii) Develop a scatter plot for sentiment vs engagement. iii) Create a bar chart to show sentiment distribution. iv) Analyze positive, negative, and neutral sentiment using calculated fields. v) Create a line chart to track sentiment trends over time. vi) Develop KPIs for engagement metrics. vii) Build an interactive dashboard.
5	Analysis of Healthcare Dataset: i) Create KPI indicators for patient count, bed occupancy, and average stay duration. ii) Develop a Bullet Graph to compare actual vs target occupancy. iii) Create Drill-through reports from hospital to department level. iv) Create a bar chart to show patient distribution across departments. v) Build a line chart for patient admission trends. vi) Analyze resource utilization using calculated fields. vii) Build an interactive dashboard.
6	Analysis of Online Retail Dataset: i) Create a Funnel Chart to visualize purchase stages. ii) Analyze drop-off rates at each stage. iii) Create a bar chart to compare product category sales. iv) Use DAX/LOD expressions to calculate purchase frequency. v) Create a heat map for customer purchase behavior. vi) Develop KPIs for revenue and conversion rate. vii) Build an interactive dashboard.
7	Analysis of Stock Market Dataset: i) Create a Candlestick Chart to visualize stock prices. ii) Add Moving Average line for trend analysis. iii) Create a line chart to compare stock performance. iv) Develop a bar chart for trading volume. v) Create calculated fields for volatility. vi) Build KPI indicators for stock performance. vii) Build an interactive dashboard.
8	Analysis of Global Renewable Energy Dataset: i) Create a Stacked Area Chart to show energy consumption trends. ii) Perform Year-over-Year (YoY) growth analysis. iii) Create a bar chart to compare energy sources. iv) Develop a line chart for renewable energy adoption. v) Create a map to visualize country-wise energy usage. vi) Develop calculated fields for growth rate. vii) Build an interactive dashboard.
9	Analysis of revenue in sales dataset: i) Create a choropleth map (fill the map) to spot the special trends to show the state which has the highest revenue. ii) Create a line chart to show the revenue based on the month of the year. iii) Create a bin of size 10 for the age measure to create a new dimension to show the revenue. iv) Create a donut chart view to show the percentage of revenue per region by creating zero access in the calculated field.

	v) Create a butterfly chart by reversing the bar chart to compare female & male revenue based on product category. vi) Create a calculated field to show the average revenue per state & display profitable & non-profitable state. vii) Build a dashboard.
10	Analysis of GDP dataset: i) Visualize the countries data given in the dataset with respect to latitude and longitude along with country name using symbol maps. ii) Create a bar graph to compare GDP of Belgium between 2006 – 2026. iii) Using pie chart, visualize the GDP of India, Nepal, Romania, South Asia, Singapore by the year 2010. iv) Visualize the countries Bhutan & Costa Rica competing in terms of GDP. v) Create a scatter plot or circle views of GDP of Mexico, Algeria, Fiji, Estonia from 2004 to 2006. vi) Build an interactive dashboard.
11	Analysis of HR Dataset: i)Create KPI to show employee count, attrition count, attrition rate, attrition count, active employees, and average age. ii) Create a Lollipop Chart to show the attrition rate based on gender category. iii) Create a pie chart to show the attrition percentage based on Department Category- Drag department into colours and change automatic to pie. Entire view, Drag attrition count to angle. Label attrition count, change to percent, add total also, edit label. iv) Create a bar chart to display the number of employees by Age group, v) Create a highlight table to show the Job Satisfaction Rating for each job role based on employee count. vi) Create a horizontal bar chart to show the attrition count for each Education field Education field wise attrition – drag education field to rows, sum attrition count to col, vii) Create multiple donut chart to show the Attrition Rate by Gender for different Age group.
12	Analysis of Amazon Prime Dataset: i) Create a Donut chart to show the percentage of movie and tv shows ii) Create a area chart to shows by release year and type iii) Create a horizontal bar chart to show Top 10 genre iv) Create a map to display total shows by country v) Create a text sheet to show the description of any movie/movies. vi) Build an interactive Dashboard.
	Part B - Mini Project
	Develop an interactive data visualization dashboard using Tableau or Power BI by selecting a real-world dataset (CSV format from Kaggle or similar sources). The project should demonstrate data preprocessing, advanced visualizations, and effective storytelling to derive meaningful insights for decision-making.

Topics for Self-learning	
Power BI	Downloading and Installation procedure
Tableau	Downloading and Installation procedure

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply advanced data visualization techniques using Tableau and Power BI.
CO2	Execute data cleaning, transformation, and preparation on real-world datasets.
CO3	Develop interactive dashboards for domain-specific applications.
CO4	Analyze datasets to derive meaningful insights using visualization techniques.
CO5	Build and present actionable insights using visual storytelling and reports.

Text Books	
1	Microsoft Power BI Data Analyst Certification Guide, Daniil Maslyuk, Greg Deckler, 2nd Edition, Packt Publishing, 2024, ISBN-13: 978-1837632053
2	Tableau Desktop Specialist Certification Guide, Mike Van Sickle, 2nd Edition, Packt Publishing, 2023, ISBN-13: 978-1803246925

Text Books	
1	Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, 2nd Edition ,Wiley, 2025, ISBN-13: 978-1394287758
2	Practical Tableau: 100 Tips, Tutorials, and Strategies, Ryan Sleeper, 2nd Edition ,O'Reilly Media, 2018, ISBN-13: 978-1491977316

Web links and Video Lectures (e – Resources)	
1	Official Documentation of Tableau https://www.tableau.com/learn
2	Official Documentation of Microsoft Power BI https://learn.microsoft.com/en-us/training/powerplatform/power-bi
3	Kaggle (Datasets & Practice) https://www.kaggle.com/datasets
4	UCI Machine Learning Repository https://archive.ics.uci.edu
5	Google Data Analytics Professional Certificate (Reference Learning) https://www.coursera.org/professional-certificates/google-data-analytics

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		3					1		2	3
CO2	2	3	1	2	3					1		2	3
CO3	2	2	3	2	3				1	2		3	3
CO4	3	3	2	3	2					2		2	3
CO5	2	2	3	1	2				2	3		2	3

Semester: IV					
JavaScript and jQuery					
Course Code	**:**	1BCSL406C	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Web Application Development with HTML and PHP.
Knowledge on Fundamental Concepts	Fundamentals of HTML and CSS, Understanding of DOM (Document Object Model), Basic concepts of events and event handling.
Knowledge on Connected Tools (If any)	VS Code, Any Web Browser.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand primitives of JavaScript Programming.
CLO2	Implement arrays and objects in JavaScript to create structured and functional programs.
CLO3	Make Use of basic jQuery methods to access and manipulate HTML elements in web pages.
CLO4	Demonstrate jQuery methods to manipulate HTML elements and handling events.
CLO5	Utilize JavaScript and jQuery concepts to develop interactive web applications, incorporating form validation and handling, animations and dynamic styling features.

Experiments	
Sl. No.	**List of problems for which student should Develop a program and execute in the Laboratory**
1.	a. Develop a JavaScript program to Capitalize the first letter of each Word of a sentence (String). b. Write a JavaScript to Check a string starts with 'Java'.
2.	a. Develop a JavaScript to display the current day and time. b. Write a JavaScript to display (on respective button clicks) multiplication and division of two numbers. Read values from the textboxes and design two buttons (use DOM).
3.	a. Develop a JavaScript to display a message using confirm and alert function on a button click. b. Develop a JavaScript to read value through prompt window and display the value on a button click.
4.	a. Develop a JavaScript to read the content of HTML paragraph and update (on button click event) with the suitable Text in the reverse order. b. Write a JavaScript to highlight all HTML <a> elements with the class name "high" in red color and, on a button click, check for the presence of the "href"

	attribute in each <a> element and display its value on the web page.
5.	a. Develop a JavaScript to sort a list of numbers using arrays and functions. b. Develop a JavaScript to create a hotel object using object literal syntax having properties like name, location, room rate, discount, etc., constructors and method (offer-price). Create few objects to demonstrate the access of properties and an associated method.
6.	a. Develop a jQuery program to disable/enable the Employee information to find DA, HRA, PF, TAX, Gross pay form and disable right click menu. b. Write a jQuery program to underline all the words and first word bold.
7.	a. Develop a jQuery program to add options to a drop-down list. b. Develop a JavaScript program to demonstrate mouse and keyboard event handling by changing the background color of a text area on mouse enter/leave, displaying mouse click coordinates and showing the key pressed in a textbox using appropriate events.
8.	a. Develop a jQuery program to delete all table rows except first row. b. Develop a jQuery program to change a CSS class different font color and background color.
9.	a. Develop a jQuery program to create and add a specified class. b. Develop a jQuery program to read and display the value entered in a Textbox and option chosen in dropdown list with relevant events.
10.	Build and demonstrate, using jQuery script, a HTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely a visible.

Open Ended Experiments

- To design and develop an interactive web application using JavaScript and jQuery.
- To apply JavaScript and jQuery concepts such as DOM manipulation, event handling, arrays, functions, objects, form validation, and dynamic HTML/CSS manipulation to solve real-world problems.

Project Requirements

- Students can select any real-world problem domain.
- The application must include:
  - Minimum two or more web pages/forms/modules.
  - User input validation using JavaScript/jQuery.
  - Use of arrays, objects, and functions for data processing.
  - DOM manipulation to dynamically update web page content.
  - Implementation of mouse, keyboard, or button events.
  - At least three jQuery methods (such as selectors, effects, animations, CSS manipulation, DOM traversal, or event handling).
  - Dynamic generation and display of results/reports based on user inputs.
  - A user-friendly and responsive interface demonstrating the integration of JavaScript and jQuery concepts.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand fundamental concepts of JavaScript and jQuery to develop programs.
CO2	Design Webpage to access and manipulate HTML with DOM and event handling.
CO3	Apply JavaScript and jQuery to build interactive web applications using DOM manipulation and event handling.
CO4	Demonstrate jQuery selectors and methods for HTML manipulation and event handling.
CO5	Develop a program to handle structured data and data items.

Textbook	
1	"JavaScript and jQuery: Interactive Front-End Web Development", Jon Duckett, 1st Edition, 2014, Wiley, **ISBN-13:** 978-1118871652.

Reference Books	
1	"Learning Web Design: A Beginners Guide to HTML, CSS, JavaScript, and Web Graphics", Jennifer Robbins, 5th Edition,2018, O'Reilly Media, **ISBN-13:** 978-1491960202.
2	"JavaScript: The Definitive Guide", David Flanagan, 7th Edition, 2020, O'Reilly Media, ISBN-13 978-14 91952023.

Web links and Video Lectures (e – Resources)	
1	https://www.w3schools.com/js/
2	https://www.javascript.com/learn/
3	https://www.netacad.com/courses/javascript-essentials-1?courseLang=en-US
4	https://www.youtube.com/watch?v=ajdRvxDWH4w&list=PLGjplNEQ1it_oTvuLRNqXfz_v_0pq6unW

CO – PO – PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1			2						2	2	1
CO2	3	2	1	1	2				1		1	2	2
CO3	3	2	2	2	2	1	1	1	1	2	2	3	2
CO4	3	2	2	2	3		1	1	1		2	3	2
CO5	3	2	3	2	3	2	1	2	1	2	2	3	3

Semester: IV					
MongoDB					
Course Code	**:**	BADL406D	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Data Structures.
Knowledge on Fundamental Concepts	Object Oriented Programming basic Concepts
Knowledge on Connected Tools (If any)	MongoDB Compass, Postman, Visual Studio

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basic functions, operators, data types, and CRUD operations in MongoDB for effective database management.
CLO2	Demonstrate the creation and use of indexing techniques in MongoDB to improve data retrieval and query performance.
CLO3	Apply aggregation pipelines and MapReduce techniques in MongoDB to process, analyze, and summarize large datasets efficiently.
CLO4	Demonstrate text searching techniques on MongoDB collections using text indexes.
CLO5	Build scalable NoSQL database solutions using MongoDB and apply best practices for data modeling, querying, and optimization.

Experiments	
Sl. No.	**List of problems for which student should Develop C program and execute in the Laboratory**
1.	Create a collection named **emp_personal_details** containing the field's emp_id, emp_name, emp_address, emp_DOB, emp_age, emp_mobile_number, emp_designation, emp_salary, emp_incentive, and emp_working_hours.
2.	a. Illustration of Where Clause, AND, OR operations in MongoDB. b. Execute the Commands of MongoDB and operations in MongoDB: Insert, Update, Delete and find.
3.	a. Insert 10 records in collection emp_personal_details and emp_professional_details. b. Show all the employees having designation manager. c. Show all the employees having salary 60000. d. Develop a MongoDB query to display the first 5 documents from the results obtained in a by using limit and find.
4.	Create and demonstrate how projection operators ($, $elematch and $slice) would be used in the MongoDB.
5.	Execute Aggregation operations ($avg, $min, $max, $push, $addToSet etc.) students encourage to execute several queries to demonstrate various aggregation operators.
6.	Execute Aggregation Pipeline and its operations (pipeline must contain $match, $group, $sort, $project, $skip etc. students encourage to execute several queries to demonstrate various aggregation operators).

7.	a. Find all listings with listing URL, name, address, host_picture_url in the listings And Reviews collection that have a host with a picture url. b. Using E-commerce collection write a query to display reviews summary.
8.	a. Demonstrate creation of different types of indexes on collection (unique, sparse, compound and multikey indexes) b. Demonstrate optimization of queries using indexes.
9.	a.Create backup of collections emp_personal_details and emp_professional_Details b.Delete some record and then restore it from backup c.Export the collection in csv and json format d.Delete some records and import the collections
10.	a. Develop a query to demonstrate Text search using catalog data collection for a given word b. Develop queries to illustrate excluding documents with certain words and phrases

Open Ended Experiments	
1	Design and implement a NoSQL database using MongoDB for a real-world application of your choice, and justify the database schema, collections, and data management strategies used
2	Design and develop a MongoDB-based Social Media Data Management System to store, manage, and analyze user profiles, posts, comments, likes, and interactions. Implement suitable MongoDB operations and generate meaningful insights from the stored data.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply MongoDB commands and queries to perform data insertion, retrieval, updating, deletion, and manipulation in database collections.
CO2	Use MongoDB aggregation pipelines to extract and analyse data from database collections.
CO3	Demonstrate query optimization techniques in MongoDB by creating and utilizing indexes to improve database performance.
CO4	Develop MongoDB aggregation pipelines and implement text search techniques to efficiently retrieve and analyze data from collections.
CO5	Create web applications utilizing MongoDB as a NoSQL database to support data-driven functionalities.

Text Books	
1	"MongoDB Complete Guide" by Manu Sharma 1st ed, bpb publication, 2023.
2	**"**MongoDB in Action" by KYLE BANKER et. al. 2nd ed, Manning publication, 2016

Reference Books	
1	**"**MongoDB: The Definitive Guide", Kristina chodorow, 2nd ed O'REILLY, 2013.

Web links and Video Lectures (e – Resources)	
1	**MongoDB in action book Code download URL: h**ttps://www.manning.com/downloads/529
2	**MongoDB Exercise URL:** https://www.w3resource.com/mongodb-exercises/

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			3							1	3
CO2	3	3	1	1	3							2	3
CO3	3	3	2	2	3							1	2
CO4	3	3	2	2	3							2	3
CO5	3	2	3	2	3							2	2

Semester: IV					
Biology for IT Engineers **(CSE, ISE, AI&ML, AI&DS & CSD)**					
Course Code	**:**	1BBI407	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	BSC	**SEE Duration**	**:**	1 Hour

Prerequisites:	
Courses	Biology and Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of cell biology, biomolecules, stem cells, enzymes, vitamins, and hormones, and their relevance to engineering applications.
CLO2	Relate the structure and functions of human organ systems to engineered devices and biomedical technologies.
CLO3	Apply bio-inspired principles and explain emerging bioengineering technologies for developing innovative and sustainable engineering solutions.

Module – 1	**05 Hrs**
Fundamentals of Biology and Biomolecules - Cell as the basic unit of life, Plant and Animal cells Prokaryotic and Eukaryotic cells, Stem cells and applications, Biomolecules: Carbohydrates, Proteins, Lipids, Nucleic acids, Enzymes, Vitamins and Hormones. **T-1&2, Ch-1.**	
Module – 2	**05 Hrs**
Biomolecules in Information Technology and Healthcare - DNA fingerprinting and Forensics , DNA and RNA vaccines , Biosensors and enzyme applications , Brain as a biological CPU , Nervous system and signal transmission , EEG and Brain-Computer Interfaces, Photosynthesis (photovoltaic cells, bionic leaf), and Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs). **T-1&2, Ch-2,3&4.**	
Module – 3	**04 Hrs**
Emerging Bioengineering Technologies - DNA Origami and Biocomputing , Tissue Engineering and Bio printing , 3D printing of biological tissues , Electronic Nose and Electronic Tongue , Bioremediation and Bio mining , Self-healing Bio concrete , Future trends in Biotechnology and Artificial Intelligence **T-1&2, Ch-5.**	

Topics for Self-learning	
Module – 1	Applications of Stem Cells in Regenerative Medicine
	Role of Biomolecules in Everyday Life
Module – 2	Brain-Computer Interfaces (BCI) and their Applications
	Artificial Intelligence in Healthcare and Disease Diagnosis
Module – 3	DNA Origami and Biocomputing
	Future Trends in Biotechnology and Artificial Intelligence

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamentals of biology, biomolecules, and their applications in healthcare and modern technologies.
CO2	Relate biological systems and processes to information processing, diagnostics, and computational technologies.
CO3	Apply emerging bioengineering innovations, including biocomputing, artificial intelligence, and sustainable solutions for healthcare and environmental challenges.

Text Books	
1	**Biology for Engineers** – Rajendra Singh C. and Rathnakar Rao N., Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
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 Education, New Delhi, 2012.

Reference Books	
1	**Biology for Engineers** – Arthur T. Johnson, CRC Press, Taylor & Francis, 2011.
2	**Biomedical Instrumentation and Measurements** – Leslie Cromwell, Prentice Hall, 2011.
3	**Biomimetics: Nature-Based Innovation** – Yoseph Bar-Cohen, CRC Press, 2012.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/121106008?utm_source=chatgpt.com
2	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009/?utm_source=chatgpt.com
3	https://onlinecourses.nptel.ac.in/noc22_bt18/preview?utm_source=chatgpt.com

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**3**				**1**	**2**					**1**
CO2	**3**	**2**			**3**	**3**	**1**				**2**
CO3	**3**	**3**			**3**	**3**					**3**

Semester: IV					
Environmental Science Project					
Course Code	**:**	1BEP408	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:0:30	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	SDC	**SEE Duration**	**:**	2 Hours

Course Learning Objectives: This course will enable the students to	
CLO1	Understand complex, real-world environmental issues, including climate change, biodiversity loss, and pollution dynamics.
CLO2	Apply scientific, technological, and engineering principles to analyze structural environmental problems.
CLO3	Train in field-based methodologies, including site surveys, environmental auditing, and data collection protocols.
CLO4	Instill critical thinking and interdisciplinary problem-solving skills required to design sustainable, preventive, or remedial solutions.
CLO5	Develop professional competencies in teamwork, collaborative project management, and effective communication of environmental findings.

Restrictions and professional conduct:
Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

Methods for project identification:
Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes:
The following structured sequence of activities is to be carried out during the semester:

Sl. No.	Project title	Measurable engineering outcome	Mapped POs	SDGs
1	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow	PO2, PO3, PO4, PO6,	SDG 11, SDG 12, SDG 13

		with measurable reduction in mixed waste.	PO8, PO10	
3	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
4	Biogas generation and power generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 11, SDG 12
5	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy generation and payback.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 9, SDG 11
6	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction.	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or adoption of healthier practices.	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11
11	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air quality monitoring system	Collect air-quality data, compare with reference limits,	PO2, PO3, PO4, PO5,	SDG 3, SDG 11, SDG 13

		and present trends along with possible mitigation suggestions.	PO6, PO10	
13	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
14	Urban greening projects	Prepare greening plan, identify planting locations, and assess environmental benefits such as shade, aesthetics, or heat mitigation.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
15	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
17	Food security initiatives / cold storage system	Estimate storage need, design a simple cold-chain concept, and document reduction in spoilage or wastage.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 9, SDG 12

Suggested Learning Resources

Textbooks

1. Benny Joseph, Environmental Studies, Tata McGraw-Hill, 2nd Edition.
2. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 2005.
3. Erach Bharucha, Textbook of Environmental Studies, University Press, latest edition as available in library.
4. M. P. Poonia and S. C. Sharma, Environmental Studies, Vikas Publishing House, latest edition as available Garg, N. R., *Project-Based Learning in Engineering Education*, Pearson India Education Services, Noida.

Reference books

1. R. Sivakumar, Principles of Environmental Science and Engineering, Cengage Learning, 2nd Edition.
2. G. Tyler Miller Jr., Environmental Science: Working with the Earth, Thomson Brooks/Cole, 11th Edition.
3. Pratibha Singh, Anoop Singh, and Piyush Malaviya, Text Book of Environmental and Ecology, Acme Learnin 1st Edition.
4. S. M. Prakash, Environmental Studies, Elite Publishing House, Mangalore, 3rd Edition, 2018.

Teaching Learning Process:

The suggested TLP for Community / Societal Project is as follows;

Week	Teaching–Learning Activity	Faculty Role	Student Activity	Output / Evidence
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic
3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objective formulation	Review and refine problem statement	Prepare problem statement, scope, and objectives	Approved problem statement
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app

11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

A. Continuous Internal Evaluation (CIE) – 50 marks

- Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.
- CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totaling 50 marks:

CIE pass requirement:

- A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.
- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE) – 100 marks (scaled to 50)

- Examination duration: 2 hours.
- Maximum examination marks: 100 (scaled to 50).
- The SEE shall be conducted batch-wise by two examiners, one faculty from the same department and one from a different department appointed by the Principal.

SEE pass requirement and overall passing rule:

- For a pass in SEE, a student shall secure minimum 35 marks out of 100.
- For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):					
Criterion	**Weight (marks)**	**Excellent (Full marks)**	**Good**	**Fair**	**Needs Improvement**
Problem identification & relevance to society/environment	8	Problem clearly identified with strong evidence of relevance and well-defined scope.	Relevant problem with clear scope and adequate evidence.	Problem defined but justification is weak.	Problem unclear or not relevant.
Formation of problem statement; engineering approach, innovation & feasibility	10	Precise statement; sound, innovative, feasible approach.	Adequate statement; feasible with minor gaps.	Partial statement; marginal feasibility.	Missing or infeasible.
Interaction with stakeholders; data collection, analysis & interpretation	8	Thorough engagement; comprehensive data and well-interpreted analysis.	Good engagement; adequate data and analysis.	Limited engagement; incomplete data and superficial analysis.	Little or no stakeholder contact; no data/analysis.
Project documentation; clarity, organization & problem-solving demonstrated	10	Complete, well-organized, analytical, and strong problem-solving.	Complete and clear with some analytical content.	Basic with omissions; problem-solving limited.	Missing/ poorly organized; no clear problem-solving.
Communication & presentation skills	6	Confident, structured, and answers queries fully; visuals effective.	Clear and satisfactory; responds to most queries.	Acceptable but lacks clarity or confidence; weak responses.	Poor or absent; unable to respond.
Contribution & benefit to society (impact, sustainability)	8	Clear, demonstrable societal benefit and realistic sustainability path.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear benefit; sustainability weak.	No evident benefit or sustainability.

SEE Rubric — Semester End Examination (Will be conducted for 100 marks; later scaled to 50 marks):					
Criterion	**Weight (marks)**	**Excellent (Full marks)**	**Good**	**Fair**	**Needs Improvement**
Problem identification & relevance to society/ Environment	16	Clearly articulated with strong evidence and context.	Clear with reasonable evidence.	Problem stated but evidence/context weak.	Poorly defined or irrelevant.
Formation of problem statement; engineering approach, innovation & feasibility	20	Precise; demonstrates engineering depth, novelty and feasibility.	Technically sound and feasible with minor limitations.	Basic; limited technical depth or feasibility concerns.	No viable engineering approach or infeasible plan.
Interaction with stakeholders; data collection, analysis & interpretation	16	Excellent engagement; rigorous data collection and insightful analysis.	Good engagement and acceptable analysis.	Superficial data collection and limited analysis.	Inadequate or no data; poor analysis.
Project documentation; clarity, technical rigor & problem-solving demonstrated	20	Comprehensive, technically rigorous, and systematic.	Complete and technically correct with minor gaps.	Lacks technical depth or has notable omissions.	Missing key elements or technically incorrect.
Communication, presentation & viva-voce responses	12	Presents expertly, defends work persuasively and answers all queries correctly.	Good presentation and satisfactory answers to most queries.	Adequate but fails to answer some technical questions.	Poor presentation and unable to defend work.
Contribution & benefit to society; impact assessment & sustainability	16	Clear, evidence-based impact assessment with scaling recommendations.	Reasonable impact discussion and sustainability considerations.	Limited evaluation of impact or sustainability.	No coherent assessment of impact or sustainability.

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and analyse environmental problems through field interaction and technical assessment.
CO2	Develop skills in project planning, field survey, data collection, implementation, documentation, teamwork and communication.
CO3	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects.

CO4	Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions.
CO5	Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback and baseline conditions.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3		3	1	2	2				
CO2				2	2				3	3	3
CO3	2	2	3			2	3				1
CO4						3	3	3			
CO5	2	3	2	2		2	2		2		

Semester: IV						
Metaphysical Science **Streams: CSE/ECE/CV/ME**						
Course Code	**:**	1BMP409		**Credits**	**:**	1
Hours/Week(L:T:P:SL)	**:**	14:0:0:16		**CIE**	**:**	50 Marks
Total Hours	**:**	30		**SEE**	**:**	50 Marks
Course Type	**:**	HSSMC		**SEE Duration**	**:**	1 Hour

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basic concepts of metaphysics, ontology, and epistemology.
CLO2	Explain metaphysical perspectives on the universe, mind, and consciousness.
CLO3	Explore the relationship between quantum metaphysics, healing and modern science.

Module 1	**05 Hrs**
Foundations of Metaphysics, Ontology and Epistemology **Introduction to Metaphysics:** Definition, scope and historical roots (Aristotle, Plato, Kant). Distinction between Metaphysics, Physics and Spirituality. **Branches of Metaphysics:** Ontology, Cosmology and Epistemology. **Fundamental metaphysical questions:** Reality, existence, abstract entities, morality. **Ontology (Study of Being):** Materialism, Idealism and Dualism, Problem of Universals: Realism vs. Nominalism **Epistemology (Study of Knowledge):** Rationalism (Descartes) and Empiricism (Locke, Hume), Theories of Truth: Correspondence, Coherence and Pragmatic, Skepticism and Constructivism, Simulation Theory and Descartes' Evil Demon **Textbook2, Ch.1-5**	
Module 2	**05 Hrs**
Cosmology, Mind and Consciousness **Metaphysical Cosmology:** Philosophical and Physical Cosmology, Time, Space and Origin of the Universe, Anthropic Principle and Fine-Tuning Debate, Creation, Causality and Infinite Regress, Multiverse Theory and its Metaphysical Implications, Ancient Cosmologies: Vedic, Taoist and Indigenous Perspectives. **Mind and Consciousness:** Nature of Mind and Consciousness, Mind-Body Problem: Dualism vs. Physicalism, Theories of Consciousness: Integrated Information Theory (IIT), Global Workspace Theory and Panpsychism, Eastern and Western Perspectives on Self and Consciousness, Artificial Intelligence and Machine Consciousness, Role of Consciousness in Observation and Decision Making **Textbook1, Ch.1-2, Textbook2, Ch.6-8**	
Module 3	**05 Hrs**
Quantum Metaphysics, Healing and Engineering Perspectives Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum Theory and Consciousness, Quantum Healing: Deepak Chopra's Model, Biofield Theory, Chakras and Subtle Energy Systems, Placebo Effect, Intention and Non-local Healing, Applications and Engineering Perspectives of Bio-resonant Technologies, Scientific evidence, limitations and ethical considerations in Quantum Healing. **Textbook1, Ch. 3-15**	

Topics for Self-learning	
Module – 1	• Indian Perspectives on Metaphysics (Advaita Vedanta, Buddhism and Jainism) • Philosophy of science and scientific realism
Module – 2	• Consciousness in meditation and mindfulness practices • AI ethics and machine consciousness • Latest developments in neuroscience and consciousness research
Module – 3	• Emerging biofeedback and wearable health technologies • Engineering applications of meditation and neurotechnology

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts of metaphysics, ontology and epistemology in understanding reality and existence.
CO2	Analyze metaphysical perspectives on cosmology, consciousness and the nature of the universe.
CO3	Evaluate the relationship between quantum theory, consciousness, healing practices and their relevance to emerging engineering applications.

Text Books	
1	Quantum Metaphysics, Tarja Kallio-Tamminen, ISBN 952-10-1927-1 Otamedia, Oy 2004.
2	Metaphysics-A Very Short Introduction, Stephen Mumford, Sl. No. 20129780191640261, 0191640263, OUP Oxford, 2012

Reference Books	
1	Deepak Chopra M.D., Quantum Healing (Revised and Updated): Exploring the Frontiers of Mind/Body Medicine, 2015.
2	Deepak Chopra M.D., Quantum Body: The New Science of Living a Longer, Healthier, More Vital Life, 2023.

Weblinks	
1	https://www.yogajournal.com/meditation/
2	https://youtube.com/shorts/JgCVh6wwgNg?si=R87-PGIrUSII774w
3	https://www.youtube.com/watch?v=XvyuUqlX7fE
4	https://core.ac.uk/download/pdf/14914967.pdf
5	https://www.youtube.com/watch?v=_ba0yIAZ9ok
6	https://www.youtube.com/watch?app=desktop&v=fzxohf49loU
7	https://www.youtube.com/watch?v=SSGKowtXS3Y
8	https://www.youtube.com/watch?v=r_piRatnFlY

CO–PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2				2		2	1		3
CO2	2	3				2		2	1		3
CO3	2	2				2	2	2	1		3

Semester: IV					
NATIONAL SERVICE SCHEME **(Common to the Branches: AD, AI, CD, CS & IS)**					
Course Code	**:**	BNS410	**Credit**	**:**	00
Hours/Semester (L:T:P:SL)	**:**	0:0:0:28	**CIE**	**:**	100 Marks
Total Hours	**:**	28	**SEE**	**:**	NA
Course Type	**:**	NCMC	**SEE Duration**	**:**	NA

Prerequisites:	
Courses	**---**
Knowledge on Fundamental Concepts	Basic understanding of social responsibility, environmental awareness, community welfare, sustainable development, ethics, teamwork, and communication skills.
Knowledge on Connected Tools (If any)	Basic use of smartphones, internet, digital communication tools (email, WhatsApp, Google Forms), presentation software (PowerPoint/Canva), video recording tools, and office productivity software (MS Word/Google Docs) for documentation and report preparation.

Course Learning Objectives: This course will enable the students to	
CLO1	**Understand** the community, identify its needs and problems, and apply knowledge to develop practical solutions for sustainable community development and welfare.
CLO2	**Develop** social and civic responsibility, leadership, teamwork, communication, and community participation skills through collaborative and service-oriented activities.
CLO3	**Demonstrate** ethical values, democratic attitudes, effective group-living skills, and responsible citizenship while contributing to social service and community development.

Activity– 1	**10 Hrs**
Environmental Sustainability: Plantation and adoption of plants (Know Your Plants), water conservation techniques, role of stakeholders, and implementation of sustainable environmental practices.	
Activity – 2	**09 Hrs**
Community Development and Rural Entrepreneurship: Organize National Integration and Social Harmony programs (minimum two), prepare actionable business proposals to enhance village income, and support community-based development initiatives.	
Activity – 3	**09 Hrs**
Educational and Social Welfare Initiatives: Government school rejuvenation, improving infrastructure, enhancing student academic performance and enrolment in higher/technical/vocational education through awareness and mentoring activities.	

Topics for Self learning	
Activity – 1	Plantation, biodiversity conservation, and sustainable water management practices.
	Climate change, environmental protection, and the role of citizens in conservation.
Activity– 2	National integration, social harmony, and community leadership.
	Rural entrepreneurship, village development, and government support schemes.

Activity – 3	School development, educational awareness, and mentoring for higher education.
	Social responsibility, volunteerism, and community engagement for sustainable development.

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution

Sl. No.	**Topic**	**Group Size**	**Location**	**Activity Execution**	**Reporting**	**Evaluation of the Topic**
1.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc…..	School selection/pro per consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 4th Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer
2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.

- In the 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion.
- At the end of the 4th semester, consolidated report of all activities compiled report should be submitted as per the instructions.

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze environmental and societal issues and propose practical, sustainable solutions by demonstrating social responsibility and civic awareness.
CO2	Evaluate and implement government and community-driven initiatives to address societal challenges and promote community development and welfare.
CO3	Demonstrate ethical values, teamwork, leadership, effective communication, and civic responsibility while participating in social service and community engagement activities.

Suggested Learning Resources:

Books:

1	NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2	Government of Karnataka, NSS cell, activities reports and its manual.
3	Government of India, NSS cell, Activities reports and its manual.

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						3	2	2	1		3	--	--
CO2						3	3	2	1		3	--	--
CO3						3	3	3	1	3	3	--	--

Semester: IV						
Physical Education (PE) (Sports & Athletics) **Common to All Branches**						
Course Code	**:**	1BPE410		**Credits**	**:**	0
Hours/Week(L:T:P:SL)	**:**	20:0:0:16		**CIE**	**:**	**100 Marks**
Total Hours	**:**	24		**SEE**	**:**	NA
Course Type	**:**	NCMC		**SEE Duration**	**:**	**NA**

Course Learning Objectives: This course will enable the students to	
CLO1	Develop an understanding of ethical principles and moral values and their importance in sportsmanship, fair play, and personal conduct in games and athletic activities.
CLO2	Acquire practical skills and demonstrate technical proficiency in selected sports or athletic events through structured physical training and performance.
CLO3	Understand the role of effective organization, administration, and management in the successful conduct of sports events and athletic programs.

Module – 1	**4 Hrs**
Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games	
Module – 2	**16 Hrs**
Specific Games (Any one to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground	
Module-3	**4 Hrs**
Role of Organization and administration	

Topics for Self-learning	
Module – 1	Sportsmanship, Fair Play and Ethical Decision-Making in Sports
Module – 2	Rules, Techniques and Performance Analysis of Volleyball / Track Events
Module – 3	Planning, Organization and Management of Sports Events

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the ethical principles, moral values, and sportsmanship essential for responsible participation in sports and games.
CO2	Perform the fundamental skills and techniques of the selected game or athletic event with discipline and teamwork.
CO3	Discuss the role of sports organizations and administration in the promotion and management of sports activities.

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
	Total	**100**

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2		3	2		2
CO2						2		2	2		2
CO3						2		2	2	2	3

Semester: IV					
Yoga **Streams: CSE/ECE/CV/ME**					
Course Code	:	1BYO410	**Credit**	:	0
Hours/Semester (L:T:P:SL)	:	14:0:0:16	**CIE**	:	100 Marks
Total Hours	:	30	**SEE**	:	NA
Course Type	:	NCMC	**SEE Duration**	:	NA

Prerequisites:	
Courses	--
Knowledge on Fundamental Concepts	• Basic understanding of physical fitness, health and personal hygiene. • Awareness of body posture, breathing, and general wellness practices.
Knowledge on Connected Tools (If any)	--

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the philosophy and principles of Patanjali's Ashtanga Yoga for holistic well-being.
CLO2	Demonstrate the correct techniques of Surya Namaskar, Yogasanas, Kriyas, and Pranayama with appropriate safety measures.
CLO3	Practice Yogic techniques to enhance physical fitness, mental wellness, and healthy lifestyle habits.

Module - 1	**04 Hrs**
Foundations of Ashtanga Yoga: Patanjali's Ashtanga Yoga: Introduction, need and importance, Eight Limbs of Yoga – Overview, Yama: Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha, Niyama: Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana. **T-1: Ch. 4**	
Module - 2	**05 Hrs**
Surya Namaskar and Yogasanas: Surya Namaskar: Concept, significance, 12-step sequence, breathing coordination, posture alignment, and practice of four rounds, Asanas: Meaning, need, importance, classification, Practice of Sitting, Standing, Prone, and Supine Asanas (Sukhasana, Paschimottanasana, Ardhakati Chakrasana, Parshva Chakrasana, Dhanurasana, Halasana, Karna Peedasana) with techniques, precautions and benefits. **T-1: Ch. 3, 4**	
Module - 3	**05 Hrs**
Kriyas and Pranayama: Kriyas: Introduction to Shatkarmas, Kapalabhati – meaning, importance, technique, precautions, and benefits, Pranayama: Meaning, need, importance, techniques, precautions, and benefits, Types of Pranayama: Suryanuloma–Viloma, Chandranuloma–Viloma, Suryabhedana, Chandrabhedana, Nadishodhana. **T-1: Ch. 5, T-2: Ch. 2**	

Topics for Self learning	
Module – 1	Role of Yama and Niyama in personal and professional ethics
Module – 2	Scientific benefits of Surya Namaskar and Yogasanas in stress management and lifestyle disorders
Module – 3	Advanced Pranayama, Meditation, and Yoga for mental health and holistic wellness

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize the philosophy, principles, and significance of Patanjali's Ashtanga Yoga and its role in healthy living.
CO2	Demonstrate Surya Namaskar, selected Yogasanas, Kapalabhati and Pranayama using proper techniques and precautions.
CO3	Practice appropriate Yogic techniques to improve physical fitness, mental concentration, emotional balance, and overall wellness.

Text Book	
1	Light on Yoga, B.K.S. Iyengar, HarperCollins Publishers India, 2006, ISBN: 978-81-7223-501-7.
2	Asana Pranayama Mudra Bandha, Swami Satyananda Saraswati, Yoga Publications Trust, Bihar School of Yoga, Munger, 2008, ISBN: 978-81-86336-14-4

Reference Books	
1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Raja Yoga, Swami Vivekananda, Advaita Ashrama, Kolkata, 2018, ISBN: 978-81-7505-151-5.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/playlist?list=PLzF4lOyPf_Z9yQ_Gphjh1wZ5fEhMg6hmP
2	https://www.youtube.com/playlist?list=PLOzRYVm0a65cCcY4qKX5MIyJxBt7hJgQY
3	https://youtu.be/KB-TYlgd1wE
4	https://youtu.be/aa-TG0Wg1Ls

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2	2				2
CO2						3	2	1			2
CO3						3	2	2			2

Semester: IV					
Music **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	1BMU410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	NA
Course Type	**:**	NCMC	**SEE Duration**	**:**	NA

Prerequisites:	
Courses	Familiarity with school-level cultural or music activities is beneficial
Knowledge on Fundamental Concepts	Basic awareness of vocal music and musical instruments.
Knowledge on Connected Tools (If any)	Metronome or Tala application for rhythm practice. Audio playback device (mobile phone/laptop) for listening to compositions.

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
CLO2	Contrast the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
CLO3	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module – 1	**05 Hrs**
Composers Biography and contributions of Purandaradasaru, Thyagarajaru, Mysuru vasudevacharyaru, Kanakadasaru. **T-3** Ch. 2-5	
Module – 2	**05 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **T-1**,V-4 – Ch. 2-6	
Module – 3	**04 Hrs**
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase andsulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga. **T-1**, V-1&2 **T-2** Ch.2-4	

Topics for Self learning	
Module – 1	Contributions of the trinity of Carnatic music (Thyagaraja, Muthuswami Dikshitar, Syama Sastri)
	Women composers and their contributions to Indian Classical Music
Module – 2	Modern electronic musical instruments used in Indian Music
	Evolution and global influence of traditional Indian musical instruments
Module – 3	Voice culture techniques and vocal health for singers
	Introduction to digital music learning tools (Shruthi Box, Tala Apps, and Online Music Platforms)

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the contributions of composers.
CO2	Classify Indian musical instruments and describe their construction and use.
CO3	Illustrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books	
1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, 2019thEdition,2021. The Indian Music Publishing House, Chennai, ASIN : B093Y3TL52 Chapters:2,3,4,5,6
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, 4th Edition ,2008,CBH Publications , ISBN 81 85 381 50 Chapters:2,3,4
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi Chapters:2,3,4,5

ReferenceBooks	
1	History of South Indian (Carnatic) Music (From Vedic Times to the Present) , R Rangaramanuja ayyangar ,2019 edition ,Vipanchi charitable trust publisher ISBN: 9788187723158.
2	Music of India, B. Chaitanya Deva, 2nd edition , 1995 Munshiram Manoharlal Publishers. ISBN-10 : 8121501954
3	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, 2013 Edition, Asian Educational Services
Web links and Video Lectures (e – Resources)	
1	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39
2	https://www.youtube.com/live/RfM4lAJQgCc?si=xfK0b6exvkBujugr
3	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1				1	1	1		1		
CO2	2		2		3	1	1	1	1		1
CO3	3			1	2	1	1	1	1		1

Semester: IV					
National Cadet Corps (NCC) – II **(General Awareness – Common Subjects) (Common to all Branches)**					
Course Code	**:**	1BNC410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	
Course Type	**:**	NCMC	**SEE Duration**	**:**	

Prerequisites:	
Courses	National Cadet Corps (NCC) – I (1BNC309), if NCC was the option chosen in III Semester
Knowledge on Fundamental Concepts	NCC, National Integration, Disaster Management, Social Awareness
Knowledge on Connected Tools (If any)	**-**

Course Learning Objectives: This course will enable the students to	
CLO1	Acquire general knowledge of health, hygiene and preventive well-being practices prescribed for NCC cadets
CLO2	Gain awareness of environmental conservation and natural-resource management as taught to NCC cadets
CLO3	Understand the elements of personality development and leadership traits expected of a responsible citizen

Module – 1	**05 Hrs**
Health and Hygiene – General Awareness Structure and Functioning of the Human Body; Hygiene and Sanitation (Personal and Food Hygiene). Physical and Mental Health (general awareness); Infectious and Contagious Diseases and their Prevention. First Aid in Common Medical Emergencies (awareness only); Introduction to Yoga Exercises.	
Module – 2	**05 Hrs**
Environment Awareness and Conservation – General Awareness Natural Resources – Conservation and Management; Water Conservation and Rain Water Harvesting. Waste Management; Pollution Control – Water, Air, Noise and Soil. Energy Conservation; Wildlife Conservation and Projects in India.	
Module – 3	**04 Hrs**
Personality Development and Leadership – General Awareness Introduction to Personality Development; Factors Influencing Personality (Physical, Social, Psychological and Philosophical); Self-Awareness. Interpersonal Relationship and Communication Skills; Leadership Traits and Types of Leadership. Attitude – Assertiveness and Negotiation; Time Management; Stress Management Skills; Interview Skills.	

Topics for Self learning	
Module – 1	Reading on personal hygiene/sanitation practices; a short note on common infectious diseases and their prevention
Module – 2	Short report on a local water-conservation or waste-management initiative; awareness reading on a wildlife conservation project in India
Module – 3	Preparation of a short self-awareness/communication-skills reflection note; practice of a mock interview with peers

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the structure and functioning of the human body and describe common health, hygiene and preventive practices
CO2	Describe key concepts of environmental conservation, natural-resource management and pollution control
CO3	Exhibit an understanding of personality development, leadership traits, communication and stress/time-management skills

Text Books	
1	Cadet's Handbook – Common Subjects (SD/SW), Directorate General NCC, Ministry of Defence, Government of India, Edition dated 06 May 2013 (or latest edition).
2	NCC Handbook for 'A', 'B' and 'C' Certificate Examinations, Upkar Prakashan, Latest Edition.

Reference Books	
1	Personality Development and Leadership – A Cadet's Guide, published by DGNCC, Latest Edition.
2	Ministry of Environment, Forest and Climate Change – awareness publications on conservation, Latest Edition.
3	NCC Directorate/Group HQ training literature and circulars, as issued from time to time.

Web links and Video Lectures (e – Resources)	
1	Directorate General National Cadet Corps – https://www.nccindia.gov.in/
2	Ministry of Environment, Forest and Climate Change – https://moef.gov.in

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2		1	1		
CO2						2	3				
CO3								2	3	3	

Semester: IV						
Competency Enhancement Course-2 **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	1BCE411		**Credits**	**:**	0
Hours/Week(L:T:P: SL)	**:**	36:0:0:24		**CIE**	**:**	100 Marks
Total Hours	**:**	50		**SEE**	**:**	NA
Course Type	**:**	NCMC		**SEE Duration**	**:**	NA

Prerequisites:	
Courses	Competency enhancement course-1
Knowledge on Fundamental Concepts	Arithmetic operations, fractions, decimals and elementary algebra. comprehension of basic English
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Enhance Quantitative Problem-Solving Skills
CLO2	Master Data Interpretation and Visual Analysis
CLO3	Strengthen Logical Reasoning and Spatial Intelligence
CLO4	Develop Advanced Verbal Aptitude and Communication Accuracy
CLO5	Sharpen Critical Thinking through Assumptions and Analytical Judgement

Module – 1	**6 Hrs**

Data Interpretation

Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs

T-1, C-36

Module – 2	**6 Hrs**

Pipes & Cisterns

Speed, Time, and Distance, Core concepts of speed, time, and distance with formula-based problem-solving techniques. Understanding the relationships between speed, time, and distance, and applying them to real-world scenarios.

Relative Speed

Calculating relative speed in scenarios involving objects moving in the same or opposite directions. Application of relative speed in solving problems on overtaking, crossing, and meeting points.

Average Speed

Techniques for calculating average speed over multiple journeys or varying speeds. Application in mixed-distance and mixed-speed problems.

Problems on Trains

Solving problems involving trains, including crossing stationary and moving objects. Concepts of platform length, tunnel length, and calculating crossing times for accurate results.

Boats and Streams

Understanding upstream and downstream speeds, including the effect of current on boat movement. Solving problems based on effective speed in both still water and flowing water scenarios.

Races

Concepts of time, distance, and lead in competitive races. Analyzing head-starts, leads, and gaps between racers, and calculating who wins and by how much.

T-1, C-14-18

Module-3	**6 Hrs**

Cubes and Dice

Introduction to the properties and visualizations of cubes and dice. Understanding different orientations and views of cubes and dice, including adjacent and opposite faces. Solving problems related to numbering, coloring, and arranging cubes and dice. Techniques to quickly analyze and answer questions on folding/unfolding and rotation. Application in spatial reasoning and enhancing 3D visualization skills.

Puzzles

Developing logical thinking and problem-solving skills through a variety of puzzles. Types of puzzles, including number puzzles, pattern recognition, arrangement, and logical deduction. Strategies for approaching and solving puzzles efficiently. Practice with common puzzle formats found in competitive exams and aptitude tests. Enhancing analytical abilities, critical thinking, and creative problem-solving through diverse puzzle exercises.

Verbal Aptitude

Reading Comprehension

Introduction to Reading Skills, Emphasizing the importance of regular reading for comprehension, vocabulary, and overall verbal aptitude. Understanding how strong reading skills benefit areas beyond comprehension, like analytical thinking and verbal reasoning. Establishing a daily reading habit to improve focus and retention.

Para Jumbles

Techniques for logically ordering jumbled sentences into a coherent paragraph. Understanding linkages between sentences, transitional words, and thematic flow.

Sentence Completion

Strategies for filling in the blanks with appropriate words or phrases. Developing skills to recognize context, tone, and logical flow for accurate sentence completion.

Antonyms/Synonyms

Building a strong vocabulary by mastering antonyms and synonyms. Practice with context-based word selection to improve vocabulary and precision in language.

T-2, C6-9,13-16

Module-4	**6 Hrs**

Verbal Aptitude

Error in Sentences

Identifying common grammatical errors in sentences, including subject-verb agreement, tense consistency, and pronoun usage. Understanding sentence structure and common pitfalls in grammar for error detection.

Sentence Rearrangement

Techniques to rearrange words or phrases to form coherent and grammatically correct sentences.

Focus on grammar, context, and logical structure for rearrangement accuracy.

Idioms and Phrases

Understanding and correctly using idioms and phrases in context. Building familiarity with common idioms to enhance comprehension and verbal accuracy.

Verbal Analogies

Solving analogies by identifying the relationships between words or phrases. Developing logical thinking to understand and complete analogy-based questions.

T-1, C28-29

Module-5	**6 Hrs**

Permutation and Combination

Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2n, Arrangement in a circle.

Probability

Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.

Crypt arithmetic

Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm.

Statements and Assumptions

Identifying implicit assumptions within a statement. Developing the ability to read between the lines and recognize underlying premises.

Statements and Conclusions

Analyzing a given statement to derive logical conclusions. Differentiating between valid and invalid inferences based on the provided information.

Cause and Effect

Understanding cause-effect relationships and identifying causation or correlation between events. Analyzing statements to determine whether one event directly influences another.

R-1, C1-6

Topics for Self learning	
Module – 1	Data sufficiency, caselet DI and interpretation of radar/scatter graphs.
Module – 2	Circular track problems, unit conversions and applications in transportation and logistics.
Module – 3	Mirror images, paper folding, advanced puzzles and vocabulary building through reading.
Module – 4	Cloze tests, critical reasoning, workplace vocabulary and commonly confused words.
Module – 5	Set theory, Venn diagrams, conditional probability and decision-making case studies.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply arithmetic and logical reasoning to solve problems.
CO2	Develop spatial and logical skills to solve cube, dice, puzzle and seating arrangement questions.
CO3	Improve reading, vocabulary, and grammar through para jumbles, sentence completion and idioms.
CO4	Enhance verbal reasoning by solving analogies, rearranging sentences and identifying assumptions and conclusions.
CO5	Apply combinatorics and probability to solve permutation, combination and crypt arithmetic problems.

Text Books	
1	**Quantitative Aptitude for Competitive Examinations** by R.S. Aggarwal Chand Publishing. – 2023.
2	**Word Power Made Easy** by Norman Lewis (ISBN- 978-0143424680), , Published by PENGUIN INDIA - 2015
3	**How to Prepare for Quantitative Aptitude for the CAT** by Arun Sharma (ISBN-978-9339205126), 6th Edition, McGraw-Hill Education - 2014

Reference Books	
1	**Puzzle Test & Seating Arrangements** by K. Kundan (ISBN: 9789394666023),1st Edition, BSC Publishing Company Pvt Ltd. - 2023
2	**A Modern Approach to Verbal & Non-Verbal Reasoning** by R.S. Aggarwal, 2025-26 Edition, S. Chand Publishing -2024

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/KWZ0lR8cCwc
2	https://youtu.be/mBtBD1N7ywQ
3	https://youtu.be/B9MhxmcwnpQ
4	https://youtu.be/VaEbefWFIlc
5	https://youtu.be/3AL_6EQmnkY

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	2	2										
CO3	1	1								3		
CO4	2	2								2		1
CO5	3	3										1

Semester: IV					
Additional Mathematics-II **(For Lateral Entry Students of all the Branches)**					
Course Code	**:**	1BMATDIP412	**Credits**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:14	**CIE**	**:**	100
Total Hours	**:**	28	**SEE**	**:**	0
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	Basic Mathematics
Knowledge on Fundamental Concepts	Basic differentiation and integration
Knowledge on Connected Tools (If any)	Basic computer knowledge.

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the geometric properties of curves using differential calculus.
CLO2	Describe the concepts of probability to understand and use probability theory for analyzing uncertainty and solving related problems.
CLO3	Demonstrate the numerical methods for modeling and solving complex engineering and scientific problems where analytical solutions are difficult to obtain.

Module – 1	**05 Hrs**
Differential Calculus: Successive differentiation-problems. Taylor's & Maclaurin's series expansions-problems. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.	
Module – 2	**05 Hrs**
Basic Probability Theory: Introduction, Sample space and Events, Axioms of Probability. Addition and Multiplication theorem. Conditional Probability. Independent events. Baye's theorem, Problems.	
Module – 3	**05 Hrs**
Numerical Method -II: Numerical solution of first-order ordinary differential equations: Taylor's series method, Modified Euler's method, Runge-Kutta method of order 4, Milne's predictor-corrector method. Problems.	

Topics for Self learning	
Module – 1	**Applications:** Maxima and minima for function of two variables.
	Self-study: Method of Lagrange's undetermined multipliers.
Module – 2	**Applications**: Analyze the performance of the algorithms.
	Self-Study: Random Variables
Module – 3	**Applications:** Estimating the approximate solutions of ODE.
	Self-Study: Adam-Bashforth method.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply and interpret the geometric properties of curves in polar coordinates by applying the principles of differential calculus.
CO2	Apply concepts of probability theory and to solve related problems.
CO3	Analyze the numerical techniques to solve numerical solution of first-order ordinary differential equations.

Textbook	
1	"Higher Engineering Mathematics", B. S. Grewal,44th Edition, 2021, Khanna Publishers, ISBN:978-81-933284-9-1. Chapter. 4,5,26,32.
Reference Books	
1	"Advanced Engineering Mathematics", Kreyszig, E., Kreyszig, H., & Norminton, E. J. (2011). 10th Edition, Wiley India Pvt. Ltd. ISBN: 9788126554232
2	"Higher Engineering Mathematics", Ramana, B. V. 25th Edition, McGraw Hill Education (India) Pvt. Ltd., ISBN: 9780070634190
3	"Engineering Mathematics for Semester I and II", C. B. Gupta, S. R. Sing and M. Kumar: Mc-Graw Hill Education (India) Pvt. Ltd, 2015. .
4	"Higher Engineering Mathematics", Dass, H. K., & Verma, R. Revised Edition. New Delhi: S. Chand Publishing. ISBN: 978812193890
5	"A Textbook of Engineering Mathematics", Bali, N. P., & Goyal, M. Laxmi Publications (P) Ltd., New Delhi. ISBN: 9788131808320.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses.php?disciplineID=111
2	http://www.class-central.com/subject/math(MOOCs)
3	http://academicearth.org/

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3								1
CO2	3	3	3								1
CO3	3	3	2								1

CSE Stream			ECE Stream		CIVIL Stream		Mechanical Stream	
	PSO1	PSO2	PSO1	PSO2	PSO1	PSO2	PSO1	PSO2
CO1	1			1		1		1
CO2	1			1		1		1
CO3	1			1		1		1

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- **Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.**
- **Promoting Excellence in Teaching, Training, Research and Consultancy.**
- **Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.**
- **Developing Entrepreneurial acumen to venture into Innovative areas.**

Department of Artificial Intelligence & Data Science

VISION

Nurturing AI & DS technocrats to be proficient in solving real-world problems

MISSION

- **Providing fundamentals to enhance niche expertise in AI & DS, cognitive computing, robotics and neural network architectures**
- **Enhancing the analytical and problem-solving abilities to meet the challenges of the future**
- **Training the students with the latest technology to become sustainable professionals**
- **Fostering a culture of collaboration and propagating industry-oriented innovations and research**
- **Establishing a stimulating learning environment to create value-based and**

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