Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and Detailed Syllabus (DJS23)

Second Year B.Tech

in

Artificial Intelligence (AI) and Data Science

(Semester IV)

Prepared by: - Board of Studies in Artificial Intelligence (AI) and Data Science

To be Recommended by: - Academic Council of Dwarkadas J. Sanghvi College of Engineering

To be Approved by: - Governing Body of Dwarkadas J. Sanghvi College of Engineering

With effect from the Academic Year: 2025-2026

Scheme for Second Year Undergraduate Program in Artificial Intelligence (AI) and Data Science: SEM IV (Autonomous)

Academic Year 2025-26

Sr. no.	Course Code	Course	Teaching Scheme				Semester End Examination (SEE) - A						Continuous Assessment (CA) - B						Aggregate (A+B)	Credits Earned	
			Theory (Hrs)	Practical (Hrs)	Tutorial (Hrs)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Term Test 3 (TT3)	Total (TT1 + TT2 + TT3)	Term Work	CA Total (B)			
1	DJS23SPC251	Probability and Statistical Inference	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	3
	DJS23SPC251T	Probability and Statistical Inference Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1	
2	DJS23SPC252	Design and Analysis of Algorithms	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	3
	DJS23SPC252L	Design and Analysis of Algorithms Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1	
3	DJS23SPC253	Artificial Intelligence	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	3
	DJS23SPC253L	Artificial Intelligence Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1	
4	DJS23SPC254L	Web Development Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1	1
5	DJS23SMD251	Introduction to Operating Systems and Networking Fundamentals	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	3
	DJS23SMD251L	Introduction to Operating Systems and Networking Fundamentals Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1	
6#	DJS23XOE261	Project Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	3
	DJS23XOE262	Cyber Security, Policies and Laws																			
	DJS23XOE263	Advanced Operations Research																			
	DJS23XOE264	Corporate Finance Management																			
	DJS23XOE265	Corporate Social Responsibility																			
	DJS23XOE266	Bioinformatics																			
	DJS23XOE267	Human Resource Management																			
	DJS23XOE268	Digital Marketing Management																			
	DJS23XOE269	Logistics and Supply Chain Management																			
7	DJS23XHS283L	Design Thinking Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1	1
8	DJS23XHS284	Universal Human Values	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	2
9	DJS23XHS284T	Universal Human Values Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1	1
10	DJS23XSC251P	Innovative Product Development II	--	2	--	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1	1
		Total	**13**	**12**	**2**	**21**	**20**	**360**	**0**	**0**	**100**	**460**	**90**	**90**	**60**	**240**	**200**	**440**	**900**	**21**	**21**

Open Electives

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Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (mins)
Theory	a. Term Test 1 (based on 40 % syllabus)	15	45
	b. Term Test 2 (on next 40 % syllabus)	15	45
	c. Assignment / course project / group discussion / presentation / quiz/ any other.	10	--
	Total marks (a + b + c)	40	--
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	As applicable
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory &Tutorial	Performance in the laboratory and tutorial.	50	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus. / * Computer-based assessment in the college premises.	60	2
Oral	Questions based on the entire syllabus.	25	As applicable
Practical	Performance of the practical assigned during the Examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the Examination and on the entire syllabus.	As per the scheme	2

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Program: Artificial Intelligence (AI) and Data Science **S.Y B.Tech Semester: IV**
Course: Probability and Statistical Inference (DJS23SPC251)
Course: Probability and Statistical Inference Tutorial (DJS23SPC251T)

Pre-requisite:

1. Calculus
2. Descriptive Statistics
3. Basics of probability

Course Objectives:

1. To understand random variables with their probability distributions to build a model.
2. To estimate population parameters from random samples and perform error analyses and use statistical estimation in training and evaluating AI/ML algorithms.
3. To understand and apply the basic concepts of statistical inference, confidence limits and hypothesis testing to validate AI/ML models.
4. To understand and apply the concepts of analysis of variance for feature selection and model comparison in AI/ML.

Course Outcomes: On completion of this course, learner will be able to:

1. Apply the concepts of probability and distributions to some case studies.
2. Demonstrate sampling distributions and estimate statistical parameters.
3. Develop hypothesis based on data and perform testing using various statistical techniques.
4. Perform analysis of variance on data.

Probability and Statistical Inference (DJS23SPC251)		
Unit	**Description**	**Duration**
1	**Random Variables and Probability Distributions** Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence. Expectation, Variance and their properties, Covariance, Correlation. Discrete Probability Distributions: Binomial Distribution, Poisson distribution. Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial. Two-dimensional random variable - Joint, marginal, conditional distributions, covariance and correlation. Application of probability distributions in predicting outcomes (e.g., classification probabilities).	09
2	**Sampling distribution** Random Sampling, Sampling Distributions, Sampling Distribution of Means, Law of Large numbers, the Central limit theorem, population distribution, Z - distribution, Student's t-distribution, F-Distribution, Chi-square distribution. Application of Chi-square test for feature independence in machine learning datasets. Statistical Estimation Theory: Characteristics of estimators, consistency, unbiasedness, unbiased estimates, efficient estimates, sufficient estimators, point estimates, interval estimates, determination of sample size for estimating mean and proportions, estimates of population parameters, probable error. Confidence interval Population mean, difference between two population means, population proportion, difference between two population proportions, variance, ratio of variances of two populations. Application of confidence intervals to evaluate model performance metrics.	06

3	**Test of Hypothesis:** Test of significance, null and alternative hypothesis, type I and type II error, factors affecting Type II error, probability of Type II error, power of test, p Value, critical region, level of significance. Parametric Test: Test the difference between sample proportion and population proportion, difference between two sample proportion, difference between sample mean and population mean with known σ and unknown σ, difference between two sample means, one tailed and two tailed tests using z-statistics and t-statistics. Test the equality of population variance using F-statistics. Non-parametric Test: Test of independence, goodness of fit using chi-square statistics, Sign Test, Wilcoxon Signed-Rank Test, Mann–Whitney U Test, Kruskal–Wallis Test, Friedman Test, Runs Test, Kolmogorov–Smirnov Test, Shapiro–Wilk Test for normality.	08
4	**Analysis of Variance (ANOVA) for data analysis** Simple linear regression, Sample size calculation, One-way ANOVA, POST-HOC Analysis (Tukey's Test), randomized block design, Two-way ANOVA. Use of ANOVA in feature selection and evaluating multiple machine learning models. Application of Two-way ANOVA for analyzing the impact of hyperparameters and data preprocessing techniques on model performance.	05
	Total Lecture Hours	28

List of Tutorials:	
Sr. No.	**Suggested Tutorials**
1	Random Variables and Probability Distributions **Scenario**: An e-commerce company wants to predict the delivery times of packages to improve customer satisfaction and optimize logistics.
2	Discrete Probability Distributions **Scenario**: A company receives an average of **10 emails per hour**. What is the probability of receiving **8 emails** in an hour? **Scenario**: A store records that customers buy **Product A (40%)**, **Product B (30%)**, and **Product C (30%)**. What is the probability that out of 5 customers: a specific number of customers will purchase each product? **Scenario**: A factory averages **2 defective items** per hour on an assembly line. What is the probability of observing **exactly 3 defective items** in an hour?
3	Continuous Probability Distributions **Scenario**: A real estate company wants to predict house prices in a neighborhood where prices are distributed around a mean value. **Scenario**: A tech company monitors the time between requests to a web server, which follows an **exponential Distribution**. **Scenario**: In NLP, distances between word embeddings are often modeled as a normal distribution. **Scenario**: When capturing images under consistent lighting conditions, pixel brightness values are uniformly distributed.
4	Central Limit Theorem **Scenario**: A company monitors the number of visitors to its website daily and wants to estimate the average number of visitors over a month. **Scenario**: You want to estimate the mean accuracy of a classification model on unseen data. **Scenario**: A company collects customer satisfaction ratings (on a scale of 1 to 5) and wants to estimate the average satisfaction level.
5	Statistical Estimation Theory **Scenario**: A retail chain wants to estimate the average amount customers spend in its stores. **Scenario**: A data scientist evaluates the accuracy of a classification model on a test dataset. **Scenario**: A public health agency wants to estimate the average blood pressure of adults in a city.
6	Confidence Interval **Scenario**: A logistics company wants to estimate the average delivery time for packages. **Scenario**: A brand monitors social media posts to estimate the average sentiment score for tweets about its product.
7	Parametric Test **Scenario**: A data scientist evaluates two machine learning models to determine if one performs significantly

	better than the other. **Scenario**: A retailer wants to evaluate whether a new marketing campaign increased average weekly sales. **Scenario**: A data scientist compares the average training time of two machine learning models to decide which one is more efficient.
8	Non-parametric Test **Scenario**: A recommendation algorithm's feature engineering is tested to see if adding a new feature improves recommendations for users, but the feature scores are not normally distributed. **Scenario**: A company measures the sentiment of posts on social media, but the sentiment score distribution is not normal, and outliers are present. **Scenario**: A researcher wants to compare multiple machine learning algorithms on a dataset where model performance scores (e.g., precision, recall) are not normally distributed.
9	**One-way ANOVA, POST-HOC Analysis (Tukey's Test)** **Scenario**: A data scientist compares the predictive accuracy of three machine learning algorithms (A,B and C) on the same dataset **Scenario**: A machine learning practitioner compares how different algorithms perform on different types of data, such as categorical vs. numerical. **Scenario**: A data scientist evaluates how different features affect the performance of multiple models
10	**Two-way ANOVA** **Scenario**: A data scientist evaluates the performance of machine learning algorithms across different types of data (e.g., structured vs. unstructured) and varying hyperparameters (e.g., regularization strength). **Scenario**: A company runs an A/B test where different marketing campaigns (e.g., email vs. social media) are tested across various customer segments (e.g., new vs. returning customers). **Scenario**: A data scientist evaluates how various data preprocessing methods (e.g., scaling, imputation) influence the performance of multiple machine learning models (e.g., decision trees, logistic regression). **Scenario**: A company tests if employee performance (e.g., sales, productivity) is influenced by the department they work in (e.g., Sales, Marketing, Customer Support) and their experience level (e.g., junior, mid-level, senior).

Minimum Eight tutorials from the above suggested list or any other tutorial based on syllabus will be included, which would help the learner to apply the concept learnt.
Each tutorial carries 25 marks.

Books Recommended:

Text books:

1. *Statistical Methods, S. P. Gupta, Sultan Chand, 2021, 46th revised edition.*
2. *Probability - Statistics and Random Processes by T. Veerarajan, McGraw Hill Education. 3rd edition, 2017.*
3. *Think Stats: Probability and Statistics for Programmers, Allen B. Downey, Green Tea Press, 2011.*
4. *Testing Statistical Hypotheses, E. L. Lehmann, Joseph P. Romano, Springer, 2008, third edition.*
5. *An Introduction to Statistics with Python, Thomas Hasalwanter, Springer, 2016.*

Reference Books:

1. *Fundamentals of mathematical statistics, S. C. Gupta, V. K. Kapoor, Sultan Chand, 12th edition,2020.*
2. *Practical Statistics for data scientists 50+ Essential Concepts Using R and Python, Peter Bruce, Andrew Bruce, Peter Gedeck, Orelly, second edition, 2020.*
3. *Statistics, Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, 2007.*
4. *Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M Ross, Elsevier, fifth edition, 2014.*
5. *Casella, G., & Berger, R. L., Statistical Inference, Cengage, 2021.*
6. *Wasserman, L., All of Statistics, Springer, 2004.*

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Program: Artificial Intelligence (AI) and Data Science **S.Y B.Tech Semester: IV**
Course: Design and Analysis of Algorithms (DJS23SPC252)
Course: Design and Analysis of Algorithms Laboratory (DJS23SPC252L)

Pre-requisite:

1. Computer Programming
2. Data structure.

Course Objectives:

1. To provide mathematical approach for Analysis of Algorithms.
2. To solve problems using various algorithmic strategies.
3. To analyze algorithms for solving problems.

Course Outcomes: On successful completion of this course, student should be able to:

1. Analyze the performance of algorithms using asymptotic analysis.
2. Apply the concept of Greedy method to solve all feasible solutions of problems
3. Find an optimal solution of problem by applying the concept of dynamic programming strategy.
4. Understand the concepts of backtracking, branch and bound to represent solution by state space tree.
5. Implement string matching techniques and Develop an understanding of approximation algorithms as a strategy to handle NP-hard problems

Design and Analysis of Algorithms (DJS23SPC252)		
Unit	**Description**	**Duration**
1	**Introduction:** Analysis of control statements and loops, solving recurrences using tee, substitution and Master's theorem. Problem solving using Divide and Conquer – Binary search, Merge sort, Quick sort, Randomized Quick Sort, Karatsuba multiplication, Max–Min problem.	**05**
2	**Greedy Method:** Introduction, properties of Greedy algorithms, Fractional knapsack, Activity selection, Job sequencing with deadlines, Graph algorithms: Minimum Spanning Tree (Prim's & Kruskal's), Single-source shortest path (Dijkstra's), Coin change, Analysis of all algorithms.	**06**
3	**Dynamic Programming:** Introduction and principle of optimality, components and characteristics of DP. Fibonacci sequence, Coin change (DP version), 0/1 Knapsack, Matrix Chain Multiplication, Floyd–Warshall (All pairs shortest path), Bellman–Ford (Single source shortest path), Travelling Salesperson Problem, Longest Common Subsequence (LCS), Analysis of all algorithms.	**08**
4	**Backtracking and Branch and Bound:** **Basics of backtracking,** N–Queens, Sum of subsets, Graph coloring and analysis of algorithms. Branch and bound**:** Introduction, types of bounding, 0/1 Knapsack using B&B.	**04**
5	**String Matching Algorithms:** The naive string-matching algorithm, The Rabin Karp algorithm, The Knuth Morris Pratt algorithm NP hard and NP Complete**:** Concept of approximation algorithms, Introduction to P, NP, NP-hard problems.	**05**
	Total	**28**

Instructions to Perform Algorithms on Competitive Programming Platforms

To implement, test, and analyze classical algorithms from Greedy, Dynamic Programming, Divide and Conquer, and Backtracking paradigms using online programming environments such as **LeetCode, HackerRank, CodeChef, Codeforces or any other Equivalent Coding Platforms**

General Guidelines

1. Students should log in to **any competitive** coding platform using their registered email ID.
2. Each algorithm listed below must be implemented using an appropriate programming language (C / C++ / Java).
3. Before coding, **analyze the algorithm's design technique**, input-output structure, and time complexity.
4. **Implement**, **compile**, and **execute** each algorithm with at least **two sample test cases**.
5. Record the output and note the **observed performance** (execution time or step count if applicable).
6. Use the **problem statement section** of the IDE to write a short description of:
    - Algorithm name
    - Problem type (Greedy / DP / Backtracking / Divide & Conquer)
    - Time and space complexity
7. Submit your **source code, output screenshots, and complexity analysis** for evaluation.
8. Maintain all records in a **lab journal (Writeup for experiment) on Microsoft Teams** for continuous assessment.

List of Experiments

1. Implementation of binary search.
2. Implementation of Min Max algorithm
3. Implementation of Karatsuba algorithm for long integer multiplication.
4. Fractional Knapsack implementation using greedy approach.
5. Implementation of Activity selection using greedy approach.
6. Implementation of Kruskal's/ Prim's algorithm using greedy approach.
7. Implementation of job sequencing with deadline using greedy approach.
8. Implementation of other greedy algorithms eg: tree vertex split, subset cover, container loading, coin changing, optimal; merge patterns (Huffman tree).
9. Implementation of Single source shortest path (Dijkstra's algorithm).
10. Implementation of Bellman Ford algorithm using Dynamic programming.
11. Implementation of Longest Common Subsequence algorithm using Dynamic programming.
12. Implementation of Travelling Salesperson problem using Dynamic programming.
13. Implementation of all pair shortest path using dynamic programming.
14. Implementation of N-queen problem using Backtracking.
15. Implementation of Knuth Morris Pratt string matching algorithm.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Minimum Ten Experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Submission Instructions

- For each experiment, submit:
    1. **Algorithm Design Technique**
    2. **Source code** (with comments)
    3. **Input/output screenshots**
    4. **Time complexity analysis**

Books Recommended:

Text books:

1. *S. Sridhar, Design and Analysis of Algorithms, 1st Edition, Oxford Education, 2018.*
2. *Design and Analysis of Algorithms, Goodrich M T, Wiley, New Delhi, 2021.*
3. *Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press,2008.*

Reference Books:

1. *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", 4TH Edition, The MIT Press, 2022.*
2. *Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication, 2015.*
3. *Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI, 2008.*
4. *John Kleinberg, Eva Tardos, "Algorithm Design", Pearson, 2005.*
5. *Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication, 2005.*

Web links:

1. *AoA: https://aofa.cs.princeton.edu/online/*
2. *DAA: https://www.coursera.org/learn/analysis-of-algorithms*
3. *Leetcode: https://leetcode.com/problemset/all/*
4. *Hackerrank: https://www.hackerrank.com/domains/tutorials/10-days-of-javascript*
5. *Codeforces: https://codeforces.com/problemset*
6. *Codechef: https://www.codechef.com/practice*

Online Resources:

1. *Fundamental Algorithms: Design and Analysis, Prof. Sourav Mukhopadhyay, IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc23_cs39/preview*
2. *Design and Analysis of Algorithms, Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan, IIT Bombay. https://nptel.ac.in/courses/106101059*
3. *Design and Analysis of Algorithms, IIT Madras. https://nptel.ac.in/courses/106106131*

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Program: Artificial Intelligence (AI) and Data Science **S.Y B.Tech Semester: IV**
Course: Artificial Intelligence (DJS23SPC253)
Course: Artificial Intelligence Laboratory (DJS23SPC253L)

Pre-requisite:

1. Foundation of Artificial Intelligence

Course Objectives:

1. To introduce the concepts of artificial intelligence, search algorithms, knowledge representation, and data analysis.
2. To apply various AI techniques, including search algorithms, knowledge representation methods, and data mining techniques, to solve real-world problems.

Course Outcomes: On successful completion of this course, student should be able to:

1. Analyze and Evaluate Search Strategies.
2. Design and Implement Heuristic and Local Search Solutions.
3. Formulate and Solve Constraint Satisfaction Problems.
4. Develop Optimal Strategies for Adversarial Environments.

Artificial Intelligence (DJS23SPC253)

Unit	Description	Duration
1	**Uninformed Search Algorithms:** Best-first search, Search data structures, Redundant paths, measuring problem-solving performance, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search and the problem of memory, Depth-limited and iterative deepening search, Bidirectional search, Comparing uninformed search algorithms	05
2	**Informed Search Algorithms:** Greedy best-first search, A* search, Search contours, Satisficing search: Inadmissible heuristics and weighted A*, Memory-bounded search, Bidirectional heuristic search, The effect of heuristic accuracy on performance, Generating heuristics from- relaxed problems, sub problems and landmarks.	06
3	**Local Search and Optimization Problems:** Hill-climbing search, TSP, Escaping Local Optima, Stochastic Local Search, Evolutionary algorithms- Genetics Algorithm, Ant Colony Optimization.	06
4	**Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.	06
5	**Adversarial Search and Games:** Game Theory, Optimal Decisions in Games- The minimax search algorithm, Alpha--Beta Pruning, Monte Carlo Tree Search, Stochastic Games, Limitations of Game Search Algorithms	05
	Total	28

List of Experiments:

1. Implement Breadth-First Search (BFS) and Depth-First Search (DFS) to find a path from a start to an end point in a simple grid-based maze. Compare the path found and the number of nodes expanded by each.
2. Implement the Uniform-Cost Search (UCS) algorithm to find the minimum-cost path in a graph where edges have varying non-negative costs. Use the Route Finding problem (e.g., city connections with distances/tolls).
3. Implement the Iterative Deepening Depth-First Search (IDDFS) algorithm and demonstrate how it combines the benefits of DFS (low memory) and BFS (optimality for unweighted paths).
4. Implement Bidirectional Search for an unweighted graph and show the intersection point to demonstrate its advantage in reducing the search frontier size.

5. Implement the Greedy Best-First Search algorithm to solve the 8-Puzzle problem, using the Manhattan Distance.
6. Implement the A* Search algorithm for pathfinding on a grid (like a map or a 2D game environment).
7. Implement A* for the 8-Puzzle problem and derive an admissible heuristic by relaxing the problem constraints.
8. Implement the Hill-Climbing Search algorithm to find the maximum value of a simple mathematical function, demonstrating its susceptibility to local optima.
9. Implement Simulated Annealing (a form of Stochastic Local Search) to find a near-optimal solution for a small instance of the Traveling Salesperson Problem (TSP).
10. Implement a basic Genetic Algorithm (GA) to find the global optimum of a known non-linear function. Focus on implementing the core steps: selection, crossover, and mutation.
11. Implement the Minimax Search Algorithm for an elementary game like Tic-Tac-Toe to ensure the AI plays an optimal game
12. Extend the Minimax implementation from Practical 12 to include Alpha-Beta Pruning. Visually demonstrate or count the number of nodes that are pruned to show the efficiency gain.
13. Implement N-Queens (N=8, 12, 16) with Heuristics using backtracking
14. Hospital Roster Generator with Preferences Tasks:14 nurses, 28-day month, 3 shifts/day, fairness + preference constraints. Hard: coverage, no 6 consecutive nights.

Minimum 10 experiments from the above suggested list or any other tutorial based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. *Saptarsi Goswami, AI for Everyone: a beginner's Handbook for AI, Pearson Publication, 2024.*
2. *Russell/Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, 2022.*
3. *Mikan, Artificial Intelligence: A Modern Approach, 2020.*

Reference Books:

1. *Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.1993.*
2. *Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication,2013.*
3. *Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education,1992.*

***Web links*:**

1. *Introduction to Artificial Intelligence* , https://nptel.ac.in/courses/106105079

Online Resources:

1. *AI and ML Projects https://thestempedia.com/blog/simple-ai-and-machine-learning-projects-for-students-and-beginners/*
2. *Problem Solving using AI* https://nptel.ac.in/courses/106105078

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Program: Artificial Intelligence (AI) and Data Science **Second Year B.Tech.** **Semester: IV**
Course: Web Development Laboratory (DJS23SPC254L)

Prerequisite: Programming Fundamentals

Course Objectives:

1. To introduce the fundamental concepts of web development using HTML, CSS, and client-side scripting.
2. To enable students to design and develop responsive and interactive web pages using CSS3, Bootstrap, and JavaScript.
3. To impart knowledge of modern front-end development frameworks like React JS and the concept of single-page applications (SPA).
4. To familiarize students with version control systems using Git and GitHub for collaborative software development.
5. To provide hands-on experience in server-side scripting using Node.js, Express.js, and MongoDB for building full-stack web applications

Course Outcomes: Students will be able to

1. Develop static and dynamic web pages using HTML5 and CSS3 with responsive design principles.
2. Implement client-side interactivity using JavaScript, including DOM manipulation, form validation, and data fetching through APIs.
3. Design and deploy React-based applications using components, states, and hooks for efficient front-end management
4. Utilize Git and GitHub for source code management, version control, and collaborative development workflows.
5. Build and integrate RESTful APIs using Node.js, Express, and MongoDB to perform CRUD operations and connect the front-end with the back-end efficiently.

Web Development Laboratory (DJS23SPC254L)		
Unit	**Description**	**Duration**
1	**HTML:** Create a static web page using HTML,Create a class timetable using HTML,Create a registration form using HTML,Create a web page using HTML5 tags.	02
2	**CSS:** Design a responsive web page and CSS3 using external CSS (media queries), Design a web page using Bootstrap, Design the admission form using Bootstrap.	02
3	**Client-Side Scripting:** Programs based on objects in JavaScript, Programs based on form validation, Fetch Data from an API Using the Fetch API in JavaScript.	04
4	**React JS:** Types of Components, Single Page Application (Virtual DOM) State React Hooks	04
5	**Introduction to Git and GitHub:** Adding files to the staging area, Push new branch Merge into the master Auto Commit	03
6	**Server-Side Scripting:** Installation and Configuration of Node.js server, Program based on inbuilt functions in Node.js	04
7	**Express & MongoDB:** Using Mongoose to make schemas in MongoDB,Making API end points using Express and testing using postman, Develop a website and integrate it with pre-defined API,Doing CRUD on database MongoDB using Express	09
	Total	**28**

List of Experiments:

1. To create a static website using basic and semantic HTML5 tags (header, nav, section, article, footer).
2. To design and display a weekly class timetable using HTML tables.
3. To design a user registration form collecting name, email, gender, and password.
4. To design a responsive layout using CSS3 and media queries.
5. To create a professional-looking admission form using Bootstrap components.
6. To validate user input fields using JavaScript before form submission.
7. To fetch and display JSON data from a public API using the Fetch API.
8. To create functional and class-based components and use useState() hook.
9. To build a simple REST API using Express and perform CRUD operations on MongoDB.
10. To demonstrate version control operations using Git and GitHub.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept

Books Recommended:

Text Books:

1. *John Dean, Web Programming with HTML5, CSS3 and JavaScript, Jones & Bartlett Learning, 2019. Glenn Johnson, Programming in HTML5 with JavaScript and CSS3", Microsoft Press, 2013 Edition.*
2. *Adam Bretz and Colin J. Ihrig, Full Stack JavaScript Development with MEAN, SitePoint Pty. Ltd., 2015.*
3. *Venkat Subramaniam, "Rediscovering JavaScript, Master ES6, ES7, and ES8", The Pragmatic Bookshelf, 2018.*
4. *Alex Banks and Eve Porcello, Learning React Functional Web Development with React and Redux, O'Reilly, 1st Edition, 2017 Edition 5.*
5. *Andrew Mead, Learning Node.js Development, Packt Publishing, 2018 Edition 6.*

***Reference Books*:**

1. *Ethan Brown, Web Development with Node and Express, O'Reilly, 2019.*
2. *Shama Hoque Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDI Express, React, and Node.js, 2nd Edition Packt Publication, 2020.*

Web links:

1. *Learn Python - MDN Web Docs - Learn Web Development, https://developer.mozilla.org/en-US/docs/Learn*
2. *freeCodeCamp - Full Stack Development, Step-by-step lessons and projects for full-stack web development, including MongoDB and REST APIs, https://www.freecodecamp.org/learn*
3. *Udemy - Full Stack Web Development Course, https://www.udemy.com/course/full-stack-web-development*

Online Resources:

1. *Introduction to Modern Application Development*
   https://archive.nptel.ac.in/courses/106/106/106106156/
2. *Full Stack Web Development*
   https://www.coursera.org/learn/fullstack-web-development

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Program: Artificial Intelligence (AI) and Data Science **S.Y B.Tech Semester: IV**
Course: Introduction to Operating Systems and Computer Networking Fundamentals (DJS23SMD251)
Course: Introduction to Operating Systems and Computer Networking Fundamentals Laboratory(DJS23SMD251L)

Pre-requisite:

1. Computer Fundamentals

Course Objectives:

1. Understand the functionality of an Operating System, its core components, and the interactions among them, focusing on scheduling, deadlocks, memory management, synchronization, file management, and I/O policies.
2. Analyze contemporary issues and challenges in protocol design within layered architecture, exploring the strengths and weaknesses of different routing protocols.
3. Analyze contemporary issues and challenges in the design and implementation of network protocols within a layered architecture, with a focus on their strengths, weaknesses, and compatibility with network standards.
4. Evaluate and compare various routing protocols, assessing their effectiveness in different network scenarios and their impact on performance, reliability, and scalability.

Course Outcomes: On successful completion of this course, student should be able to:

1. Understand the architecture and functionality of computer systems and operating systems, focusing on process, thread management, and optimizing system efficiency through scheduling algorithms.
2. Apply principles of concurrency to address classical synchronization problems, and implement deadlock handling and memory management strategies.
3. Demonstrate data communication concepts at the physical layer and differentiate between the ISO-OSI and TCP/IP models.
4. Design networks with appropriate IP addressing schemes, including subnetting and supernetting, and analyse networking protocols at the data link and transport layers.

Introduction to Operating Systems and Computer Networking Fundamentals(DJS23SMD251)		
Unit	**Description**	**Duration**
1	**Operating System overview:** Evolution of operating system, monolithic vs. microkernel, Types of Operating Systems	02
2	**Process Management:** Concept of a Process, Process States, creation and termination, Process Description, Process Control Block. Threads: Concept of a Thread, Types of Threads Thread states, Concept of Multithreading, Scheduling: Types of Schedulers, Types of Scheduling mechanisms, Preemptive and Non-preemptive, Scheduling algorithms and their performance evaluation: FCFS, SJF, SRTF, Priority based, Round Robin.	06
3	**Deadlock and Memory management:** Deadlock: Principles of deadlock, Conditions for deadlock, Resource Allocation Graph, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery. Solution using Semaphore and Monitor. Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best Fit, First Fit, Worst Fit, Next Fit, Relocation, Paging, Segmentation. Virtual Memory: Structure of Page Tables, Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Thrashing.	06
4	**Introduction to Networking**: Introduction to computer network, network application, Network topologies and devices. Reference models: Layer details of OSI, TCP/IP model Physical and Data Link Layer: Types of Media, Duties of Data Link Layer, Error Detection and Correction (Hamming Code, CRC, Checksum), Sliding Window CSMA/CA, CSMA/CD, Wired LANS: Ethernets	06
5	**Network Layer:** Network Layer design issues, IPv4 Addressing (Classfull and Classless), IPv4 Protocol, IPv6 Protocol, Network Address Translation (NAT), Routing algorithms: Link state routing, Distance Vector Routing Protocols	05

	Congestion control algorithms: Open loop congestion control, Closed loop congestion control, Token & Leaky bucket algorithms.	
6	**Transport Layer and Application Layer:** Port Addressing, Transport service primitives, Connection management (Handshake, Teardown), UDP, TCP, Working of: DNS, HTTPS, SMTP, Telnet, FTP.	03
	Total	28

List of Experiments.

1. Explore Linux Commands
2. Write a program to demonstrate the concept of preemptive and non-preemptive scheduling algorithms.
3. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.
4. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.
5. Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN.
6. Execute and evaluate network administration commands and demonstrate their use in
7. different network scenarios.
8. Building of wired & wireless topology using Cisco Packet Tracer.
9. Write a program to implement A) Error Detection and Correction B. Framing
10. Write a program to implement Sliding Window Protocols- Selective Repeat, Go Back N.
11. Write a program to implement Congestion Control algorithms.
12. Write a program to find out class of a given IP address, subnet mask & first & last IP
13. address of that block.
14. Implement the TCP and UDP socket programming for client server architecture.

Minimum 10 experiments from the above suggested list or any other tutorial based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. *William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.*
2. *Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons , Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0*
3. *Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition, 2011*
4. *Andrew S. Tanenbaum, David J. Wetherall, - Computer Networks, Pearson Education, 6th edition 2021*
5. *Behrouz A. Forouzan, -Data Communications and Networking‖, TMH ,9th edition 2022*
6. *Oliver C Ibe - Fundamentals of Data Communication Networks, Wiley Publications ,2nd edition 2022.*
7. *James F. Kurose, Keith W. Ross, -Computer Networking, A Top-Down Approach Featuring the Internet‖, Pearson Education, 8th edition 2021.*

Reference Books:

1. *Achyut Godbole and Atul Kahate, Operating Systems, Mc Graw Hill Education, 3rd Edition, 2017*
2. *Behrouz A. Forouzan, Firouz Mosharraf, Computer Networks: A Top-Down Approach, Mc Graw Hill, 2023.*
3. *Dhanashree K. Toradmalle, Computer Networks and Network Design, Wiley, 2020.*

***Web links*:**

1. *Introduction to Operating Systems Specialization*,https://www.coursera.org/specializations/codio-introduction-operating-systems
2. *Networking Essentials*, https://www.netacad.com/courses/networking/networking-essentials
3. *The Bits and Bytes of Computer Networking*, **https://www.coursera.org/learn/computer-networking**

Online Resources:

1. Emergence of Networks & Reference Models, https://nptel.ac.in/courses/106/105/106105081

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Program: Open Elective for all Programs	S.Y. B.Tech.	Semester: IV
Course: Project Management (DJS23XOE261)		

Pre-requisite:

1. Basic concepts of Management.

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for every unique project undertaken, utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: On completion of the course, the learner will be able to:

1. Explain project management life cycle and the various project phases as well as the role of project manager.
2. Apply selection criteria and select an appropriate project from different options.
3. Create a work break down structure for a project and develop a schedule based on it. Manage project risk strategically.
4. Use Earned value technique and determine & predict status of the project. Capture lessons learned during project phases and document them for future reference.
5. Differentiate between traditional waterfall approach and agile scrum methodology for software development projects.

Project Management (DJS23XOE261)		
Unit	**Description**	**Duration**
1	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical). Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Introduction to project leadership, ethics in projects, Multicultural and virtual projects, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI).	08
2	**Initiating Projects:** How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter, Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	08

3	**Project Planning:** Work Breakdown structure (WBS) and linear responsibility chart, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques, PERT, CPM. Crashing project time & Resource loading and levelling (Only Theory), Project Stakeholders and Communication plan. **Risk Management in projects:** Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability, and impact matrix. Risk response strategies for positive and negative risks.	09
4	**Monitoring and Controlling Projects**: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, communication and project meetings. Earned Value Management techniques for measuring value of work completed, using milestones for measurement, change requests and scope creep, Project audit, Project Contracting: Project procurement management, contracting and outsourcing. **Closing the Project:** Customer acceptance, Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report, doing a lessons learned analysis, acknowledging successes and failures.	09
5	**Agile project management:** Agile principle, Agile Manifesto, Agile process framework, Characteristics of Agile Approaches and Scrum, Benefits of Agile project management, Implementing Agile project management. **Agile Project Planning:** Comparison of Agile Project Management with Traditional Waterfall Approach, Project Planning with Scrum, Scrum Artifacts Supporting Project Planning , Scrum Events for Project Planning. Scheduling with scrum, Techniques for scrum scheduling-Poker estimation. **Agile Tools for Tracking Project Progress:** Task Boards, Burnup and Burndown Charts.	08
	Total	42

Books Recommended:

Text Books:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 11th Edition, Wiley India.
2. Project Management: The Managerial Process, 8th edition, Erik Larson, Clifford Gray, McGraw Hill Education.
3. Agile Project Management, Jim Highsmith, Pearson Education, Low Price Edition, India.

Reference Books:

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 7th Ed, Project Management Institute PA, USA.
2. Project Management, Gido Clements, Cengage Learning.
3. Project Management, Gopalan, Wiley India.
4. Project Management, Dennis Lock, 9th Edition, Gower Publishing England.
5. Agile Essentials You Always Wanted to Know, Kalpesh Ashar, Vibrant Publishers U.S.A.

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Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Cyber Security, Policies and Laws (DJS23XOE262)		

Pre-requisite:

1. Fundamentals of Computers.

Objectives:

1. Familiarize with the provisions and implications of the Digital Personal and Data Protection Act, the obligations of data fiduciaries, the rights and duties of data principals, and mechanisms for resolving breaches.
2. Equip individuals and organizations with the knowledge and tools to create secure cyber ecosystems, strengthen regulatory frameworks, and develop incident response plans.

Outcomes: On completion of the course, the learner will be able to:

1. Understand and describe the major types of cybercrime and navigate legal frameworks and regulations concerning digital personal and data protection.
2. Implement strategies for cybersecurity outlined in the National Cyber Security Policy.
3. Apply appropriate law enforcement strategies to both, prevent and control cybercrime.
4. Comprehend regulations and strategies pertaining to AI (Artificial Intelligence) and large language models.

Cyber Security, Policies and Laws (DJS23XOE262)		
Unit	**Description**	**Duration**
1	**Cyber Crime:** Definition and Origin of the Word, Cyber Crime and Information Security, who are Cyber Criminals, Classification of Cybercrimes, E-mail Spoofing, Spamming, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Forgery, Newsgroup Spam, Online Frauds, Pornographic Offenders, Email Bombing, Password Sniffing, Credit Card Frauds.	08
2	**Cyber Offenses:** How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack: Active Attacks, Passive Attacks, Social Engineering, Classification of Social Engineering, Cyber Stalking: types of Stalkers, Cyber Cafe and Cyber Crimes, Botnets, Attack Vectors, Cyber Crime and Cloud Computing.	08
3	**Indian IT Act** Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments Security aspect in Cyber-Law, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, Security Standards: SOX, GLBA, HIPAA, NIST Cyber Security Framework (CSF).	09

4	**India's Digital Personal and Data Protection Act (2023)** Preliminary, Obligations of Data Fiduciary, Rights and Duties of Data Principal, Special Provisions, Data Protection Board of India, Powers, Functions and Procedure to Be Followed by Board, Appeal and Alternate Dispute Resolution, Penalties and Adjudication.	**08**
5	**India's AI Regulation and Strategy** Privacy, Security and Artificial Intelligence, Differential Privacy, Security in AI. National Artificial Intelligence Strategy, Principles for Responsible AI, Information Technology (Intermediary Guidelines and Digital Media Ethics Code-2021), Draft National Data Governance Framework Policy (NDGFP), Rules against Deepfakes, Due diligence advisory for AI, AI regulations framework (June 2024).	**09**
	Total	**42**

Books Recommended:

Text Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole, Sunit Belapur, Wiley-2011.
2. Understanding Cybersecurity Management in Decentralized Finance: Challenges, Strategies, and Trends by Gurdip Kaur, Springer-2023.

Reference Books:

1. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
2. Izzat Alsmadi , The NICE Cyber Security Framework: Cyber Security Intelligence and Analytics, Springer-2023.

References (Web Resources):

1. Digital Personal Data Protection Act 2023.pdf (meity.gov.in)
2. National Cyber Security Policy (draft v1 (meity.gov.in)
3. CISO_Roles_Responsibilities.pdf
4. Standards (bis.gov.in)
5. AI, Machine Learning & Big Data Laws & Regulations | India (globallegalinsights.com)

Evaluation Scheme:

Continuous Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.
2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks

Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise of 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Advanced Operations Research (DJS23XOE263)		

Pre-requisite:

1. Operation Research
2. Mathematics (Calculus)

Objectives:

1. To develop an ability to analyse the structure and mathematical model of various complex system occurring in manufacturing system, service system, and business applications.
2. To develop knowledge of the mathematical structure of linear and nonlinear optimization models.
3. To develop an understanding of the techniques used to solve linear and nonlinear optimization models using their mathematical structure.
4. To develop an understanding of the use of modelling languages for expressing and solving optimization models.

Outcomes: On completion of the course, learner will be able to:

1. Apply Duality theory to solve linear programming problem and analyse optimum solution.
2. Construct linear integer programming models and apply the O.R. algorithms and techniques to solve linear integer programming problems.
3. Determine best satisfying solution under a varying quantity of resources and priorities of the goals.
4. Set up decision models and solve nonlinear programming- unconstrained optimization problems.
5. Set up decision models and solve nonlinear programming- constrained optimization problems.

Advanced Operations Research (DJS23XOE263)		
Unit	**Description**	**Duration**
1	**Dual Linear Programs** Primal, dual, and duality theory - The dual simplex method -The primal- dual algorithm-Duality applications. Post optimization problems: Sensitivity analysis.	06
2	**Integer Programming** ure and mixed integer programming problems, Solution of Integer rogramming problems — Gomory's all integer cutting plane method and ixed integer method, branch and bound method, Zero-one programming	06
3	**Goal Programming** Concept of Goal Programming, GP model formulations, Graphical method of GP, The simplex method of GP, Application areas of GP	12

4	**Nonlinear Programming- Unconstrained optimization** Minimization and maximization of convex functions- Local & Global optimum- Convergence-Speed of convergence. one-dimensional unconstrained optimization — Newton's method — Golden-section search Method , multidimensional unconstrained optimization Gradient method steepest ascent (descent) method — Newton's method.	12
5	**Nonlinear Programming- Constrained optimization** Constrained optimization with equality and inequality constraints. Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions Rate of convergence - Engineering Applications Quadratic programming problems-convex programming problems	06
	Total	42

Books Recommended:

Text Books:

1. Operations Research, Gupta, P. K. and Hira, D. S., S. Chand Publications, 2014.
2. Operations research: Principles and applications, Srinivasan, G., Prentice Hallof India, 2007.
3. Non-Linear Programming-A Basic Introduction, Nita H. Shah, Poonam Prakash Mishra, CRC Press, 2020.

Reference Books:

1. Introduction to Operations Research, Frederick S. Hillier & Gerald J. Lieberman, McGraw-Hill: Boston MA; 8th. (International) Edition, 2005.
2. Operations Research — Principle and Practice Ravindran, Philips and Soleberg, Second Edition, John Wiley, and sons, 2007.
3. Operations Research - An Introduction: Taha, H. A., Pearson Education, 2022.
4. Operations Research: models and methods, Paul A. Jensen, Jonathan F. Bard, Wiley Publications, 2003
5. Optimization Techniques in Operation Research, C. B Gupta, I.K. International Publishing House Pvt. Limited, 2008.

Evaluation Scheme:

Continuous Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) — 15 marks.
2) Term Test 2 (on next 40 % syllabus) — 15 marks.
3) Assignment / course project / group discussion / presentation / quiz — 10 marks Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise of 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

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Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Corporate Finance (DJS23XOE264)		

Pre-requisite:

1. Nil

Objectives:

1. Overview of Indian financial system, instruments and market.
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management.
3. Knowledge about sources of finance, capital structure, dividend policy.

Outcomes: On completion of the course, learner will be able to:

1. Understand Indian finance system.
2. Apply concepts of time value money and risk returns to product, services and business.
3. Understand corporate finance and working capital management.
4. Take Investment and finance decisions.
5. Take dividend decisions.

Corporate Finance Management (DJS23OCOE404)		
Unit	**Description**	**Duration**
1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market. Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges.	**09**
2	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	**09**
3	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance-investment Decision, Financing Decision, and Dividend Decision.: **Working Capital Management:** Concepts of Meaning Working	**08**

	Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
4	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	08
5	**Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches — Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure **Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches — Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	08
	Total	42

Books Recommended:

Textbooks:

1. Financial Management, Theory & Practice 8th Edition (2011), by Prasanna Chandra: Tata McGraw Hill Education Private Limited, New Delhi.
2. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
3. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Reference Books:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, l0th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.

Evaluation Scheme:

Continuous Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.
2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks

Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise of 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

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Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Corporate Social Responsibility (DJS23XOE264)		

Objectives:

1. To understand the fundamental concepts and significance of Corporate Social Responsibility (CSR) in a global and Indian context, exploring its historical evolution, key stakeholders, and the benefits for business and society.
2. To analyse and apply ethical frameworks such as Utilitarianism, Deontology, and Virtue Ethics, guiding responsible decision-making in corporate governance, supply chains, and other CSR applications.
3. To examine CSR legislation, trends, and corporate initiatives within India and globally, with a focus on Section 135 of the Companies Act 2013, Schedule VII, and Public-Private Partnerships, enhancing student understanding of regulatory and strategic CSR drivers.

Outcomes: On completion of the course, the learner will be able to:

1. Explain and critique the concept of CSR and its evolution, understanding its relevance and impact on stakeholders in both business and societal contexts.
2. Apply ethical theories and frameworks to real-world CSR issues, demonstrating an understanding of ethical decision-making processes in business scenarios.
3. Interpret and analyse CSR-related legislation and compliance requirements in India, particularly the Companies Act 2013, and assess how these laws shape corporate behaviour and responsibilities.
4. Evaluate the key drivers of CSR in India, understanding market pressures, civil society influence, and regulatory frameworks, while assessing case studies of successful CSR initiatives.
5. Design and propose CSR strategies and community engagement programs that align with sustainable development goals, emphasising corporate volunteering, stakeholder engagement, and public-private partnerships.

course name (course code)		
Unit	**Description**	**Duration**
1	**Introduction to Corporate Social Responsibility (CSR)** - Understanding the concept of CSR - Historical evolution and development of CSR - Importance and benefits of CSR for businesses and society - Stakeholder theory and its relevance to CSR	07
2	**Ethical Foundations of CSR** - Ethical theories relevant to CSR (Utilitarianism, Deontology, Virtue Ethics) - Ethical decision-making frameworks in business - Corporate governance and ethics - Ethical issues in supply chain management	09
3	**CSR-Legislation in India and the World** Section 135 of Companies Act 2013.Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and Computation of Net Profit's Implementing Process in India	09
4	**The Drivers of CSR in India** Market based pressure and incentives, civil society pressure, the regulatory environment in India Counter trends, Review of current trends and	09

	opportunities in CSR, Review of successful corporate initiatives and challenges of CSR. Case Studies of Major CSR Initiatives Corporate Social Responsibility and Public-Private Partnership (PPP)	
5	**Social Responsibility and Community Engagement** - Social issues and challenges in contemporary society - Corporate philanthropy and community development initiatives - Stakeholder engagement strategies - Corporate volunteering and employee engagement programs - CSR as a strategic business tool vital for sustainable development	08
	Total	42

Books Recommended:

Text Books:

1. Andrew Crane, Dirk Matten , "Corporate Social Responsibility: Definition, Core Issues, and Recent Developments" Oxford University Press.
2. O. C. Ferrell, John Fraedrich, Linda Ferrell , "Business Ethics: Ethical Decision Making & Cases", Cengage Learning
3. Corporate Social Responsibility in India, Sanjay K Agarwal, Sage Publications, 2008
4. Corporate Social Responsibility in India, Bidyut Chakrabarty, Routledge, New Delhi, 2015

Reference Books:

1. Corporate Social Responsibility: An Ethical Approach, Mark S. Schwartz, Broadview Press, 2011
2. Attaining Sustainable Growth through Corporate Social Responsibility, George Pohle and Jeff Hittner, IBA Global Business Services, 2008
3. Strategic Corporate Social Responsibility: Stakeholders in a Global Environment, William B. Werther Jr. and David Chandler, 2nd Edition, Sage Publications, 2011

Web References:

1. NPTEL : Corporate social responsibility By Prof. Aradhna Malik
   https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg20/
2. Business Roundtable on CSR : https://www.businessroundtable.org/
3. World Business Council for Sustainable Development: https://www.wbcsd.org/
4. UN Global Compact on CSR: https://www.unglobalcompact.org/
5. Ministry of Corporate Affairs, India CSR Policy :
   https://www.csr.gov.in/content/csr/global/master/home/aboutcsr/about-csr.html
6. Harvard Business Review on CSR and Business Strategy: https://hbr.org/

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Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Bioinformatics (DJS23XOE266)		

Pre-requisite:

1. Nil

Course Objectives:

1. To provide an overview of bioinformatics and its significance in modern biological research.
2. To enable students to apply bioinformatics methods in practical scenarios for biological data analysis and interpretation.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the structure and function of cells, organelles, and biomolecules.
2. Understand the types of data stored in bioinformatics databases and their relevance to biological research.
3. Explore genomic databases and understand the structure and content of protein databases.
4. Understand system biology concepts and molecular evolution.
5. Apply knowledge of cellular and molecular biology concepts to analyze a biological problem.

Bioinformatics (DJS23OCOE406)		
Unit	**Description**	**Duration**
1	**Module 1: Foundations of Molecular and Cellular Biology** **Introduction to molecular biology:** DNA, RNA, proteins, and their roles in cellular processes **Cell structure and function:** Organelles, membrane structure, and cellular transport **Cell cycle regulation:** phases of the cell cycle, checkpoints, and cell cycle control mechanisms	**08**
2	**Module 2: Genetics and Genomics** **Mendelian genetics:** Inheritance patterns, Punnett squares, and genetic crosses **Chromosome structure and organization:** karyotyping, gene mapping, and genetic linkage **Introduction to genomics:** genome structure, organization, and variation Techniques in molecular genetics: PCR, DNA sequencing, and gene Cloning	**09**

3	**Module 3: Genomic and Protein Databases** Types of genomic databases such as GenBank, Ensemble, and UCSC Genome Browser, Understand the structure and content of protein databases such as UniProt and Protein Data Bank (PDB), biological databases and their classification, genome sequence databases, protein structure databases, composite databases. Searching, Retrieving, and Analysing Genomic and Protein data from online databases, Human genome project	09
4	**Module 4: Systems Biology** **Introduction to Systems Biology**: Modeling biological systems and network analysis, Bioinformatics tools for systems biology and modeling complex biological processes. **Principles of molecular evolution**: Mutation, Selection, and genetic drift. **Phylogenetic analysis**: Tree construction, sequence alignment, and molecular clock.	09
5	**Module 5: Applications and Case Studies** Applications of Bioinformatics in Medicine, Agriculture, and Biotechnology, Case Studies (Integrating Cellular and Molecular Biology with Bioinformatics) and Research Examples, Ethical and Legal Issues in Bioinformatics, Future Trends and Emerging Technologies in Bioinformatics.	07
	Total	**42**

Books Recommended:

Textbooks:

1. Bioinformatics For Dummies", Jean-Michel Claverie and Cedric Notredame, For Dummies. (2019)
2. Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner, Active Learning Publishers (2019)

Reference Books:

1. Introduction to Bioinformatics, Arthur Lesk, Biologist & Bioinformatics Expert, 2019
2. Introduction to Biomedical Data Science, Robert Hoyt, Informatics Education, 2019
3. Python for Biologists: A Complete Programming Course for Beginners, Martin Jones, Oxford University Press, 2013
4. An Introduction to Bioinformatics Algorithms, Neil C. Jones, and Pavel A. Pevzne, MIT Press,2004.
5. Exploring Bioinformatics: A Project-Based Approach, Caroline St. Clair, and Jonathan E. Visick, Jones & Bartlett Learning, 2014.

Evaluation Scheme: Continuous

Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.
2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks

Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise of 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

Prepared by	Checked by	Head of the Department	Vice-Principal	Principal
Meenal Rane				

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Human Resource Management (DJS23XOE267)		

Pre-requisite:

1. Nil

Objectives:

1. To introduce the students to basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today 's organizations
3. To familiarize the students with the importance of the labour relations in the organization.

Outcomes: On completion of the course, the learner will be able to:

1. Understand and distinguish the changing environment of the HRM and the role of the HR managers.
2. Understand and analyze the recruitment process and the application of IT.
3. Understand and examine the importance of training and development.
4. Understand and determine the pay plans, performance appraisal and compensation.
5. Understand and explain the importance of labour relations, employee security and collective bargaining.

Human Resource Management (DJS23OCOE407)		
Unit	**Description**	**Duration**
1	**Human Resource Function** Human Resource Philosophy – Changing environments of HRM – Strategic human resource management – Using HRM to attain competitive advantage – Trends in HRM – Organization of HR departments – Line and staff functions – Role of HR Managers.	08
2	**Recruitment & Placement** Job analysis: Methods - IT and computerized skill inventory - Writing job specification - HR and responsive organization. Recruitment and selection process: Employment planning and forecasting - Building employee commitment: Promotion from within - Sources, Developing and Using application forms - IT and recruiting on the internet. Employee Testing & selection: Selection process, basic testing concepts, types of test, work samples & simulation, selection techniques, interview, common interviewing mistakes, Designing & conducting the effective interview, small business applications, computer aided interview.	10

3	**Training & Development** Orientation & Training: Orienting the employees, the training process, need analysis, Training techniques, special purpose training, Training via the internet. Developing Managers: Management Development - The responsive managers - On-the-job and off-the-job Development techniques using HR to build a responsive organization. Performance appraisal: Methods - Problem and solutions - MBO approach - The appraisal interviews - Performance appraisal in practice. Managing careers: Career planning and development - Managing promotions and transfers.	08
4	**Compensation & Managing Quality** Establishing Pay plans: Basics of compensation - factors determining pay rate - Current trends in compensation - Job evaluation - pricing managerial and professional jobs - Computerized job evaluation. Pay for performance and financial incentives: Money and motivation - incentives for operations employees and executives - Organization wide incentive plans - Practices in Indian organizations. Benefits and services: Statutory benefits - non-statutory (voluntary) benefits - Insurance benefits -retirement benefits and other welfare measures to build employee commitment.	08
5	**Labour relations and employee security** Industrial relations and collective bargaining: Trade unions - Collective bargaining - future of trade unionism. Discipline administration - grievances handling - managing dismissals and separation. Labour Welfare: Importance & Implications of labour legislation - Employee health - Auditing HR functions, Future of HRM function.	08
	Total	42

Books Recommended:

Text Books:

1. Pattanayak, Biswajeet, Human Resource Management, 6th Ed,PHI Learning Pvt. Ltd., 1 Jul 2020
2. Gary Dessler, Human Resource Management, 16th Ed, Pearson Publications, 2020

Reference Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
3. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
4. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
5. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

6. Raymond J. Stone, Anne Cox, Mihajla Gavin, Human Resource Management, 10th Ed,John Wiley & Sons, 14 Dec 2020.
7. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing.

Evaluation Scheme:

Continuous Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.
2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks

Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

Prepared by Checked by Head of the Department Vice-Principal Principal

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Digital Marketing Management (DJS23XOE268)		

Pre-requisite:

1. Nil

Objectives:

1. Explain the evolution and technology of digital marketing, including underlying frameworks.
2. Understand digital business strategy and emerging business structures.
3. Cover digital marketing planning, operations setup, and implementation of search campaigns, alongside emerging concepts like Big Data, IoT, SMB, B2B marketing, and SoLoMo.

Outcomes: On completion of the course, the learner will be able to:

1. Understand the digital marketing framework & model and consumer behaviour.
2. Develop digital marketing strategy roadmap.
3. Explain the terminology and concepts for developing web-specific media plans.
4. Understand concepts related to digital campaign management and revenue generation models.
5. Get a perspective on global digital marketing technology/tools and future trends.

Digital Marketing Management (DJS23OCOE408)		
Unit	**Description**	**Duration**
1	**Introduction to Digital Marketing** Emergence of Digital Marketing as a tool, media consumption drivers for new marketing environment, applications and benefits of digital marketing. **Digital Marketing Framework** Delivering enhanced customer value, market opportunity analysis and digital services development, ASCOR framework **Digital Marketing Models Creation** Factors impacting digital marketplace, value chain digitization, business models. **The Consumer for Digital Marketing** • Consumer behavior on the internet, evolution of consumer behavior models, managing consumer demand, integrated marketing communications (IMC)	08
2	**Digital marketing Strategy Development** Elements of assessment phase, macro-micro environmental analysis, marketing situation analysis. **Digital Marketing Internal Assessment and Objectives Planning** Analyzing present offerings mix, marketing mix, core competencies analysis and internal resource mapping. Digital	11

	presence analysis, digital marketing objectives development and review. **Digital Marketing Strategy Definition** Understanding digital business strategy and structures, consumer development strategy, offering mix for Digital, digital pricing models, managing promotional channels and developing the extended Ps- People, process, programs and performance. **Digital marketing Strategy Roadmap** Developing digital marketing strategy roadmap, the 6s digital marketing implementation strategy, marketing across the product life cycle.	
3	**Digital Marketing Planning and Setup** Understanding digital media planning terminology and stages, steps to creating marketing communications strategy, introduction to search marketing, display marketing, social media marketing. **Digital Marketing Operations Setup** Basics of lead generation and conversion marketing, website content development and management, elements of user experience, web usability and evaluation.	**08**
4	**Digital marketing Execution** Basic elements of digital campaign management, search execution, display execution, social media execution, content marketing. **Digital marketing Execution Elements** Digital revenue generation models, managing service delivery and payments, managing digital implementation challenges like e commerce, internal & external and consumer specific challenges.	**08**
5	**Digital Business – Present and Future** Digital Marketing – Global Landscape, digital marketing overview – global spend, advertising spend, and technology/tools landscape. Data technologies (Big data and IOT) impacting marketing, segment based digital marketing and SoLoMo – the next level of hyperlocal marketing.	**07**
	Total	**42**

Books Recommended:

Text Books:

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson Education Limited,2017
2. Digital Marketing by Seema Gupta- McGraw Hill Education, 2022

Reference Books:

1. Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing by Dave Chaffey and P. R. Smith, 5 th edition, Taylor & Francis, 2017
2. Digital Marketing: Strategy, Implementation and Practice- 6 th edition by Dave Chaffey Fiona Ellis-Chadwick, Pearson Education Limited,2019
3. Digital marketing by Vandana Ahuja, Oxford University Press, 2015
4. The Art of Digital Marketing by Ian Dodson, John Wiley & Sons, 2016

Evaluation Scheme:

Continuous Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.

2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Logistics & Supply Chain Management (DJS23XOE269)		

Pre-requisite:

1. Latest trend of information technology in retail industry and logistic applications.

Objectives:

1. To develop advanced strategic thinking skills in supply chain management and logistics to effectively analyse and optimize supply networks.
2. To attain proficiency in leveraging cutting-edge tools and technologies to enhance supply chain efficiency and supply chain transformation.
3. Design and implement collaborative supply chain and sourcing strategies to promote information sharing and optimise coordination.

Outcomes: On completion of the course, learner will be able to:

1. Develop a sound understanding of the important role of supply chain management in today's business environment.
2. Develop criteria and standards to achieve improved business performance by integrating and optimizing the total logistics and supply-chain process.
3. Summarize the value of focusing on information business logistics systems which drives improved accuracy and decision-making at all levels of management.
4. Become familiar with current supply chain information technology management trends.
5. Use available technologies to enhance work performance and support supply chain functions, processes, transactions, and communications.

Logistics & Supply Chain Management (DJS23OCOE409)		
Module	**Description**	**Hours**
1	**Introduction** What Is Supply Chain Management? The Development Chain, Global Optimization, Managing Uncertainty and Risk, The Complexity in Supply Chain Management, Key Issues in Supply Chain Management .	05
2	**Network planning** Introduction, Network Design- Data Collection, Data Aggregation, Transportation Rates, Mileage Estimation, Warehouse Costs, Warehouse Capacities, Potential Warehouse Locations, Service Level Requirements, Future Demand, Model and Data Validation, Solution Techniques, Key Features of a Network Configuration Supply Chain Planning; Inventory Positioning and Logistics Coordination -Strategic Safety Stock.	07
3	**The Value of Information** Introduction, The Bullwhip Effect-Quantifying the Bullwhip Effect, The Impact of Centralized Information on the Bullwhip Effect, Methods for Coping with the Bullwhip Effect, Information Sharing and Incentives, Effective Forecasts, Information for the Coordination of Systems, Locating Desired Products, Lead-Time Reduction, Information and Supply Chain Trade-offs-Conflicting Objectives in the Supply Chain, Designing the Supply Chain for Conflicting Goals ,Decreasing Marginal Value of Information.	09

4	**Supply chain integration** Introduction, Push, Pull, and Push-Pull Systems-Push-Based Supply Chain, Pull-Based Supply Chain, Push-Pull Supply Chain ,Identifying the Appropriate Supply Chain Strategy, Implementing a Push-Pull Strategy The Impact of Lead Time Demand-Driven Strategies The Impact of the Internet on Supply Chain Strategies-what is E-Business, the Grocery Industry , the Book Industry , the Retail Industry and Impact on Transportation and Fulfillment.	**09**
5	**Information Technology and Business Process** Introduction, The Importance of Business Processes, Goals of Supply Chain IT Supply Chain Management System Components, Decision-Support Systems IT for Supply Chain Excellence, Sales and Operations Planning Integrating Supply Chain Information Technology. Implementation of ERP and Decision Support System.	**06**
6	**Technology standards** Introduction, IT Standards, Information Technology Infrastructure-Interface Devices, System Architecture and Electronic Commerce. Service-Oriented Architecture (SOA)-Technology Base: IBM and Microsoft and ERP Vendor Platform: SAP and Oracle. Radio Frequency Identification (RFID)- applications, point of sale data , business benefits and supply chain efficiency.	**06**
	Total	**42**

Books Recommended:

Text Books:

1. Sunil Chopra, Peter Meindl "Supply Chain Management-Strategy, Planning, and Operation", Pearson Publications 2016
2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, "Designing and Managing the Supply Chain-Concepts, Strategies, and Case Studies", McGraw-Hill/Irwin 2008

Reference Books:

1. Ian Sadler, "Logistics and Supply Chain Integration", SAGE Publications, 2007
2. Donald Waters, "Supply Chain Management - An Introduction to Logistics", Bloomsbury Publishing, 2019
3. Dimitris Folinas, "E-Logistics and E-Supply Chain Management-Applications for Evolving Business , IGI Global publications, 2013
4. Martin Christopher, "Logistics & Supply Chain Management", Pearson Education publications, 2016

Evaluation Scheme:

Continuous Assessment (A):

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.
2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks

Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise of 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

Prepared by | Checked by | Head of the Department | Vice-Principal | Principal

Program: Artificial Intelligence and Data Science	S.Y.B.Tech	Semester : IV
Course : Design Thinking Laboratory(DJS23XHS283L)		

Prerequisite:

1. Basic understanding with the development life cycle of products, processes, software, or services.
2. Basic knowledge of iterative frameworks (not mandatory).

Course Objectives: The Objective of course is: The Objective of course is

1. To introduce students to the fundamentals, history, and importance of design thinking and its role in solving complex, real-world problems.
2. To develop students' empathy and user-research skills by teaching them how to gather insights, create personas, and map user journeys.
3. To equip students with the skills to define and reframe problem statements effectively, identifying opportunity areas and stakeholder touchpoints.
4. To foster creative ideation, prototyping, and testing skills through hands-on exercises that incorporate strategic innovation and rapid prototyping techniques.

Course Outcomes: On completion of this course, learner will be able to:

1. Understand and apply the design thinking process to analyze and solve real-world problems.
2. Develop the ability to empathize with users, create user personas, and design empathy and journey maps tailored to specific challenges.
3. Demonstrate proficiency in defining clear and actionable problem statements that uncover areas of opportunity.
4. Generate diverse ideas using ideation techniques, such as brainstorming and SCAMPER, to approach problem-solving creatively and collaboratively.
5. Create and test prototypes, iterating based on feedback and validating solutions through digital platforms and peer review.

Design Thinking Laboratory(DJS23XHS283L)		
Detailed Syllabus:		
Unit	**Description**	**Duration**
1	**Introduction to Design Thinking and Strategic Innovation** Understanding the fundamentals of design thinking. Exploring the history and evolution of design thinking. The importance of empathy in the design thinking process. Conduct market & industry research by observing and contextualizing various macro & micro trends. Case Study - conduct their research on how Design Thinking helped solve some of the biggest and most critical problems of our time. Design Thinking for Strategic Innovation: Types of innovations, strategic innovation. Features of strategic innovation. Design thinking and strategic innovation. Practices of integrating design thinking in strategic innovation.	08

2	**Empathize Phase:** Techniques for conducting user research and gathering insights. Creating user personas and empathy maps. Practicing active listening and observation skills. To apply various empathizing techniques to the problem statement selected. Use walk-a-mile immersion and heuristic reviews to first empathize with end users and then to build an empathy map and customer journey map.	04
3	**Define Phase:** Defining problem statements and reframing challenges. Tools for synthesizing research findings. Developing a clear and actionable problem statement. Start building from Persona map and conduct interviews/ Gemba walk to plot user's journeys from start to end. Define the problem space using the HMW statement. Now highlight areas of opportunities in the journey map and enlist potential channels/touchpoints as well as stakeholders for proposed solution interventions.	05
4	**Ideate Phase:** Generating creative ideas through brainstorming sessions. Techniques for divergent and convergent thinking. Prototyping and experimenting with ideas. Apply suitable ideation technique to quickly generate diverse ideas that could be applied to target problem space – either partially or in full. Brain Writing – Build on each other's ideas and constructively & creatively develop better ideas using SCAMPER technique.	05
5	**Prototype and Validation:** Introduction to prototyping tools and techniques. Rapid prototyping methods. Testing prototypes with users and gathering feedback. Refining solutions based on user insights. Develop user storyboard to layout solution proposition in visual and easily explainable form. Run a quick peer validation. peer-validated the storyboard. Build an interactive digital prototype using any digital rapid prototyping platform and seek user validation.	06
	Total	**28**

Books Recommended

Text books:

1. I. Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", Wiley, 2013.
2. M. Lewrick, P. Link, and L. Leifer, "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems", Wiley, 2018.
3. T. Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2010.
4. K. T. Ulrich and S. D. Eppinger, "Product Design and Development", McGraw-Hill Hill Education, 6th Edition, 2016.
5. C. J. Meadows and C. Parikh, "The Design Thinking Workbook: Essential Skills for Creativity and Business Growth", Emerald Publishing, 2022.

Reference books:

1. T. Kelley and D. Kelley, "Creative Confidence: Unleashing the Creative Potential Within Us All", HarperCollins Publisher, 2013.
2. T. Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", HarperCollins, 2013.
3. J. Knapp, J. Zeratsky, and B. Kowitz, "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days", Simon & Schuster, 2016.
4. Chakrabarti, "Engineering Design Synthesis: Understanding, Approaches and Tools", Springer, 2002.
5. K. Otto, and K. Wood, "Product Design", Prentice Hall, 2000.

Web Resources:

1. Design and Innovation: https://openstax.org/books/entrepreneurship/pages/4-suggested-resources
2. Overview of Design Thinking:
   1.1 https://www.interaction-design.org/literature/topics/design-thinking
   1.2 10 Models for Design Thinking. In 2004, business consultants Hasso… | by Libby Hoffman □ Dream Doula | Medium
3. Understand, observe and define the problem: https://www.nngroup.com/articles/empathy-mapping/
4. Ideation and prototyping:
   1.1 https://www.interaction-design.org/literature/topics/prototyping
   1.2 https://www.uxmatters.com/mt/archives/2019/01/prototyping-user-experience.php
5. Testing and implementation:
   1.1 https://www.nngroup.com/articles/usability-testing-101/
   1.2 https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning.
6. Design thinking in various sectors:

https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm

Online Courses: NPTEL

1. Creative Engineering Design (https://nptel.ac.in/courses/107108010)
2. Understanding Creativity and Creative Writing (https://nptel.ac.in/courses/109101017)
3. Understanding Design Thinking & People Centred Design (https://nptel.ac.in/courses/109104109)
4. Design Thinking - A Primer (https://nptel.ac.in/courses/110106124)
5. Product Engineering and Design Thinking (https://nptel.ac.in/courses/112105316)

Suggested List of Experiments:

Design Thinking Laboratory(DJS23XHS283L)	
Sr. No.	**Name of the Experiment**
1	To conduct market and industry research and analyze case studies demonstrating the application of design thinking. (Increased understanding of how design thinking has been applied to solve critical problems in various contexts.)

2	To exercise empathizing techniques to understand the needs and pain points of a target audience.
3	Developing empathy maps and customer journey maps based on collected insights.
4	To exercise different tools and techniques (such as affinity diagrams, journey mapping, and user story mapping) for synthesizing research findings.
5	Develop user personas to represent different user archetypes and their needs concerning the problem at hand.
6	To practice the SCAMPER technique, Brainstorming, and brain-writing as a collaborative ideation technique to create multiple creative ideas/ solutions for the problem at hand.
7	Create a mind map to generate a wide range of solutions to a problem at hand.
8	To explore different prototyping tools and platforms, such as Adobe XD, Figma, Sketch, and InVision.
9	To Conduct rapid prototyping sessions to build low-fidelity / High fidelity prototypes based on the ideas generated in the Ideation phase and iterate based on feedback received.
10	Develop a plan for implementing the final solution, considering factors like scalability and feasibility.
11	Conduct usability testing to gather feedback on prototypes. Use A/B testing to compare different versions of a solution and determine which performs better.

A minimum of ten experiments from the above-suggested list or any other assignment based on the syllabus will be included, which would help the learner to apply the concept. The mini- project is mandatory.

Prepared by | Checked by | HoD | Vice Principal | Principal

Program: **Group B** **S.Y B. Tech.** **Semester: IV**
EXTC_MECH_AIML_AIDS_ICB

Course: Universal Human Values (DJS23XHS284)

Course: Universal Human Values Tutorial (DJS23XHS284T)

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Outcomes: On completion of the course, the learner will be able to:

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

Universal Human Values (DJS23XHS284)		
Unit	**Description**	**Duration**
1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct	5

	priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels	
2	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body'. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Self-regulation and health.	5
3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family- the basic unit of human interaction, understanding values in human-human relationship; meaning of Justice and program for its fulfilment. Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family). Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family!	9
4	**Understanding Harmony in the Nature and Existence - Whole existence as Co-Existence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence	5
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics:** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations	4
	Total	**28**

Tutorials: (Term work)

Term work shall consist of minimum 5 activities based on activities conducted.
The tutorials could be conducted as per the following topics: -

Activity No 1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and co-existence) rather than as arbitrariness in choice based on liking-disliking.
Activity No 2	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.
Activity No 3	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
Activity No 4	Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.
Activity No 5	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

The final certification and acceptance of term work will be subject to satisfactory performance of activities and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Textbooks:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

Reference Books:

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

Evaluation Scheme:

Continuous Assessment (A):

Term Work: - 25 marks

Will consist of following three components:

1) Term Test 1 (based on 40 % syllabus) – 15 marks.
2) Term Test 2 (on next 40 % syllabus) – 15 marks.
3) Assignment / course project / group discussion / presentation / quiz – 10 marks

Total summing up to 40 marks.

Semester End Examination (B):

Theory:

Question paper based on the entire syllabus will comprise of 4 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 60 marks.

Prepared by | Checked by | Head of the Department | Principal

Program: Artificial Intelligence (AI) and Data Science										Semester: IV	
Course: Innovative Product Development II										Course Code: DJS23XSC251P	
Teaching Scheme (Hours/week)				Evaluation Scheme							
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)				Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.		
				--			--	--	--		--
				Laboratory Examination			Semester review			Average	25
--	2	--	1	Oral	Practical	Oral & Practical	Review 1	Review 2			
				--	--	--	25	25	25		

Course Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value-added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

Course Outcome:

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyze the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare them to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity logbook is to be prepared by each team, wherein the team can record weekly

progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.

- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department.
- Efforts are to be made by the students to try and publish a technical paper, at a suitable publication (National /International),approved by the department research committee/ Head of the department.
- The focus should be on self-learning, the capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, ie during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, the focus shall also be on each individual student's contribution to the team activity,their understanding and involvement as well as responses to the questions being raised at all points in time.

Review/Progress monitoring committee may consider the following points during the assessment.

The tentative rubrics that can be followed can be as follows:

Review 1:

i. Literature Review (Algorithms, Techniques, and Methodologies) / Product Review (Review of at least 5 technical papers).
ii. Presentation Quality
iii. Contribution as a team member and Punctuality

Review 2:

i. Analysis of Literature Review
ii. Problem Statement and proposed solution
iii. System Process flow Diagram
iv. Presentation Quality
v. Contribution as a team member and Punctuality
vi. Project Documentation

Prepared by | Checked by | Head of the Department | Vice-Principal | Principal