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

Computer Science and Engineering (Data Science)

(Semester IV)

Scheme of Semester IV (DJS23) for Department of Computer Science and Engineering (Data Science)

Sr. No.	Course Code	Course	Teaching Scheme				Semester End Examination (SEE) - A						Continuous Assessment (CA) - B							Aggre gate (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)	Term Test Total (TT1 + TT2+ TT3)	Term Work	CA Total (B)			
1	DJS23DPC251	Data Structures	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
	DJS23DPC251L	Data Structures Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1	
2	DJS23DPC252	Machine Learning - I	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
	DJS23DPC252L	Machine Learning - I Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1	
3	DJS23DPC253	Statistics for Data Science	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
	DJS23DPC253L	Statistics for Data Science Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	1	
4	DJS23DMD251L	Web Engineering Laboratory	--	4	--	2	2	--	--	--	50	50	--	--	--	--	50	50	100	2	2
5#	DJS23XOE261	Project Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE262	Cyber Security, Policies and Laws	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE263	Advanced Operations Research	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE264	Corporate Finance Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE265	Corporate Social Responsibility	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	3
	DJS23XOE266	Bioinformatics	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE267	Human Resource Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE268	Digital Marketing Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE269	Logistics and Supply Chain Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
6	DJS23XHS281T	Professional and Business Communication Tutorial	--	--	2	2	--	--	--	--	--	--	--	--	--	--	50	50	50	2	2
7	DJS23XHS282	Economics and Financial Management	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	2
8	DJS23XSC251P	Innovative Product Development II	--	2	--	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1	1
		Total	**14**	**12**	**2**	**22**	**18**	**300**	**25**	**--**	**100**	**425**	**75**	**75**	**50**	**200**	**200**	**400**	**825**	**22**	**22**

Open Elective Courses

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
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.	60	2
	* Computer based assessment in the college premises.		
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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Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Computer Science and Engineering (Data Science)

(Semester IV)

Second Year B.Tech. (DJS23)

Programme Core Courses

Program: B.Tech in Computer Science and Engineering (DataScience)   **Semester: IV**

Course: Data Structures (DJS23DPC251)

     Data Structures Laboratory ((DJS23DPC251L)

Pre-requisite: C-Programming

Objectives:

To introduce and familiarize students with linear and non-linear data structures, their use in fundamental algorithms and design & implementation of these data structures. To introduce students to the basics of algorithms and time complexity. To familiarize students to various sorting and searching techniques, and their performance comparison.

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

1. Classify various linear and non-linear data structures.
2. Solve the problem using an appropriate data structure.
3. Analyze the problem and use a suitable data structure for it.

Unit	Description	Duration
	Data Structures (DJS23DPC251)	
1	**Basics of Algorithms:** Algorithms, Characteristics of an Algorithm, Time and Space Complexities, Order of Growth functions, Preliminary Asymptotic Notations.	**04**
2	**Introduction to Data Structures:** Introduction, need of Data Structures, Types of Data Structures, Abstract Data Types (ADT). **Linear Data Structures – Linked List:** List as an ADT, Array-based implementation, Linked List implementation, singly linked lists, circularly linked lists, doubly-linked lists, All operations(Insertion, Deletion, Merge, Traversal, etc.), Applications of linked lists - Polynomial Addition.	**09**
3	**Linear Data Structure – STACK:** Stack as an ADT, Operations, Array and Linked List representation of Stack, Applications – Reversing data, Conversion of Infix to prefix andpostfix expression, Evaluation of postfix and prefix expressions, balanced parenthesis, etc.	**05**
4	**Linear Data Structure – QUEUE:** Queue as an ADT, Operations, Implementation of Linear Queue, Circular and Priority Queue using arrays and Linked List, DEQueue, Applications –Queue Simulation.	**05**
5	**Non-Linear Data Structure – TREES:** Tree Terminologies, Tree as an ADT, Binary Tree - Operations, Tree Traversals, Binary Search Tree (BST) - Operations, Expression Trees, K-Dimensional Tree. **Height Balanced Tree**: Creation of AVL Tree. **HEAP**: Operations on heap, Heap Sort. **Applications**: Huffman coding. **GRAPHS**: Representation of Graph using arrays and Linked List.	**10**

6	**Searching**- Linear Search, Binary Search and Fibonacci search. **Sorting:** Bubble Sort, Selection Sort, Heap Sort, Insertion Sort, Radix Sort, Merge Sort, Quick Sort. Analysis of Searching and Sorting Techniques. **Hashing:** Hash Functions, Overflow handling, Collision & Collision Resolution Techniques, Linear hashing, Hashing with chaining, Separate Chaining, Open Addressing, Rehashing and Extendible hashing.	09
	Total	42

Data Structures Laboratory (DJS23DPC251L)	
Exp.	**Suggested experiments**
1	Implementations of Linked List using menu driven approach.
2	Implementation of different operations on linked list –copy, concatenate, split, reverse, count no. of nodes etc.
3	Implementation of polynomials operations (addition, subtraction) using Linked List.
4	Implementations of stack using menu driven approach.
5	Implementations of Infix to Postfix conversion.
6	Implementation of prefix and postfix evaluation using menu driven approach.
7	Implementation of parenthesis checker using stack.
8	Implementations of Linear queue using menu driven approach.
9	Implementations of circular queue using menu driven approach.
10	Implementations of double ended queue using menu driven approach.
11	Implementation of Priority queue program using array and Linked list.
12	Implementations of Binary Tree using menu driven approach.
13	Implementation of Binary Tree Traversal.
14	Implementations of BST.
15	Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, counting only leaf nodes in the tree.
16	Implementations of Graph traversal using menu driven program (DFS & BSF).
17	Implementations of Selection sort, Radix sort using menu driven.
18	Implementations of Heap & Heap Sort using menu driven program.
19	Implementations of Advanced Bubble Sort and Insertion Sort using menu driven Program.
20	Implementations of searching methods (Index Sequential, Fibonacci search, Binary Search) using menu driven program.
21	Implementation of hashing functions with different collision resolution techniques.

Minimum eight experiments from the above-suggested list or any other experiment or mini project based on syllabus will be included, which would help the learner to apply the concept learnt.

*The Term Work will be calculated based on Laboratory Performance (15m) and Quizzes (10m).

Books Recommended:

Text books:

1. Reema Thareja, "Data Structures using C", 3rd Edition, Oxford, 2023.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, W. H. Freeman and Company, 2010.
3. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C", 2 nd Edition, Cengage Learning, 2007.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Pres, 2009

Reference Books:

1. Mark A. Weiss, Data Structures and Algorithm Analysis in C, 4th Edition, Pearson, 2014.
2. M. T. Goodritch, R. Tamassia, D. Mount, Data Structures and Algorithms in C++, Wiley, 2nd Edition, 2011.
3. Kruse, Leung, Tondo, Data Structures and Program Design in C, Pearson Education, 2nd Edition, 2013.
4. Tenenbaum, Langsam, Augenstein, Data Structures using C, Pearson, 2nd Edition, 2015.
5. Aho, Hopcroft, Ullman, Data Structures and Algorithms, Addison-Wesley, 2010.
6. Seymour Lipschutz, Data Structures, Schaum's Outline Series, Tata McGraw-Hill, 1st Edition, 2014.

Web Links:
1. Tech Guide: https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/
2. NPTEL Course: https://nptel.ac.in/courses/106102064

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Program: B.Tech in Computer Science and Engineering (Data Science)   **Semester: IV**

Course: Machine Learning - I (DJS23DPC252)
      Machine Learning - I Laboratory (DJS23DPC252L)

Prerequisite:
1. Mathematics for Intelligent Systems
2. Python Programming

Objectives:
1. To introduce the concepts of computation learning theory and techniques of Machine Learning.
2. To become familiar with regression, classification and clustering tasks.

Outcomes: On completion of the course, learner will be able to:
1. Apply given machine learning techniques for a problem.
2. Analyze various machine learning algorithms by comparing their performance, examining optimization functions, and identifying their advantages/disadvantages.
3. Evaluate a given dataset for the selection of an appropriate machine learning algorithm and the quality of the results.
4. Design applications using machine learning algorithms.

Machine Learning - I (DJS23DPC252)		
Unit	**Description**	**Duration**
1	**Introduction to Machine Learning:** Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps involved in developing a Machine Learning Application, Hypothesis and Inductive Bias, Bias-Variance Trade-off, Performance measures, Data Validation.	**04**
2	**Supervised Machine Learning:** **Regression:** Linear Regression, Least Minimum Slope (LMS) algorithm, Gradient Descent, Lasso and Ridge Regression. Polynomial Regression. Logistic Regression, Maximum Likelihood Function.	**08**
3	**Supervised Machine Learning:** **Classification:** Introduction to decision tree, Learning Decision tree using ID3 and Gini index; CART, Overfitting. Ensemble methods: Bagging (Random Forest) and Boosting (AdaBoost and Gradient Boost).	**08**
4	**Supervised Machine Learning:** **Bayesian Learning:** Introduction to Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian Belief Network, Inference in Bayesian Network, Applications of Bayesian Network.	**06**
5	**Supervised Machine Learning:** **Support Vector Machine:** Support Vectors, Functional Margin, Geometric Margin, Optimization problem, Lagrange Duality, KKT condition, Maximum margin with noise, Non-linear SVM and Kernel Function. **Dimensionality Reduction:** Singular Value Decomposition (SVD) and Principal Component Analysis (PCA), t-distributed Stochastic Neighbor Embedding (t-SNE).	**06**

6	**Unsupervised Machine Learning:** **Association Rule Mining:** Market Basket Analysis, Apriori algorithm and measures of association. **Clustering:** Partition based clustering (K-means, K-Medoid), Hierarchal Clustering (Agglomerative Clustering), Density Based Clustering (DBSCAN) and Distribution Based Clustering (Expectation Maximisation (EM), Gaussian Mixture Model (GMM)).	10
	Total	42

Students should be encouraged to write these programs from scratch to develop better understanding of the algorithms. Last 30 minutes of the laboratory should be utilized as a discussion on available python libraries and hyperparameters.

Machine Learning - I Laboratory (DJS23DPC252L)	
Exp.	**Suggested Experiments**
1	Perform Linear Regression.
2	Perform Logistic Regression.
3	Perform Decision Tree using GINI.
4	Perform CART decision tree algorithm.
5	Perform Ensemble methods.
6	Perform Bayesian Classification.
7	Perform Support Vector Machine.
8	Perform K-means clustering.
9	Perform Association Rule Mining.
10	Mini project based on any machine learning application.

Above experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

*The Term Work will be calculated based on Laboratory Performance (15m) and Mini Project (10m).

Books Recommended:
Textbooks:
1. Ethem Alpaydın, 'Introduction to Machine Learning', MIT Press, 4th Edition, 2020.
2. Tom M.Mitchell, 'Machine Learning', McGraw Hill, 1st Edition, 2017.
3. Peter Harrington, 'Machine Learning In Action', DreamTech Press, 1st Edition, 2012.

Reference Books:
1. Andreas C. Müller and Sarah Guido, 'Introduction to Machine Learning with Python: A Guide for Data Scientists', O'reilly, 1st Edition, 2016.
2. Stephen Marsland, 'Machine Learning An Algorithmic Perspective', CRC Press, 2nd Edition, 2014.
3. Kevin P. Murphy, 'Machine Learning — A Probabilistic Perspective', MIT Press, Illustrated Edition, 2012.
4. Han Kamber, 'Data Mining Concepts and Techniques', Morgann Kaufmann Publishers, 3rd Edition, 2011.

Web Links:
1. Towards Data Science: https://towardsdatascience.com D
2. Machine Learning — Andrew Ng, Stanford University:
   https://youtube.com/playlist?list=PLLssT5z_DsKh9vYZkQkYNWcItqhlRJLN

3. Commonly used Machine Learning Algorithms:
   https://www.analyticsvidhya.com/blog/2017/09/common-machinelearning-algorithms/
4. A Tour to Machine Learning Algorithms: https://machinelearningmastery.com/a-tour-of-machine-learningalgorithms/

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Program: B.Tech in Computer Science and Engineering (Data Science)   **Semester: IV**

Course: Statistics for Data Science (DJS23DPC253)

Statistics for Data Science Laboratory (DJS23DPC253L)

Prerequisite: Probability and Statistics.

Objectives:
To build the strong foundation in statistics which can be applied to analyze data and make predictions.

Outcomes: On completion of the course, learner will be able to:
1. Examine relations between data.
2. Demonstrate sampling distributions and estimate statistical parameters.
3. Classify data using LDA and evaluate model performance with metrics.
4. Develop hypothesis based on data and perform testing using various statistical techniques.
5. Perform analysis of variance on data.

Statistics for Data Science (DJS23DPC253)		
Unit	**Description**	**Duration**
1	**Sampling distribution** • Central limit theorem. • Probability of sample mean using Sampling distribution. • Chi-square distribution. • Z – distribution. • Student's t-distribution. • F-Distribution. **Statistical Estimation:** • Confidence interval of population mean using large and small samples. • Confidence interval of difference in population means using large and small samples. • Confidence interval of population proportion. • Confidence interval of difference in population proportions. • Confidence interval of population variance and standard deviation. • Confidence interval of ratio of population variances and standard deviations. • Estimation of sample size for single mean and single proportion.	10
2	**Hypothesis Testing for data driven decision making:** • Hypothesis testing: 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. • Tests using z-statistics: 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. • Test using t-statistics: difference between sample mean and population mean, difference between two independent sample means, difference between means from the same group, paired-t test. • Test using F-statistics: equality of population variances. • Test using chi-square statistics: difference between population variance and sample variance, test of independence, goodness of fit, contingency table.	12

3	**Analysis of Variance (ANOVA) for data analysis:** • One-way ANOVA with POST-HOC Analysis (Tukey's Test) • Two-way ANOVA.	05
4	**Correlation:** • Scatter plot, • Karl Pearson's coefficient of correlation, • correlation vs causation • limits of correlation coefficient • Spearman's rank correlation coefficient, Repeated ranks **Regression:** • lines of regression • regression coefficients, • scatter plot with regression lines • coefficient of determination • multiple regression • F-test for model significance	10
5	**Statistical Analysis:** • Linear Discriminant Analysis (LDA). • Metrics: FP measures, Confusion Matrix, Accuracy, Precision, Recall, F1-score, Area under the curve (AUC).	05
	Total	42

Statistics for Data Science Laboratory (DJS23DPC253L)	
Exp.	**Suggested Experiments**
1	To perform correlation on data.
2	To visualize regression on data.
3	To prove central limit theorem.
4	To study sampling distributions and their parameters.
5	To perform statistical estimation tests on data.
6	To calculate confidence interval for different parameters.
7	To perform LDA on given datasets
8	To calculate metrics of regression on data
9	To perform hypothesis test using t statistics. (Single mean, difference between means, paired t test)
10	To perform hypothesis test using Chi square. (Contingency table)
11	To perform hypothesis test using Chi square. (Goodness of fit)

*The Term Work will be calculated based on Laboratory Performance (15m) and Assignment/Quizzes (10m).

Books Recommended:
Textbooks:
1. S. P. Gupta, 'Statistical Methods', Sultan Chand, 46th Edition, 2021.
2. Thomas Hasalwanter, 'An Introduction to Statistics with Python', Springer, 1st Edition, 2016.
3. Allen B. Downey, Think Stats: Probability and Statistics for Programmers, Green Tea Press, 1st Edition, 2011.
4. Testing Statistical Hypotheses, E. L. Lehmann, Joseph P. Romano, Springer, 3rd Edition, 2008.

Reference Books:
1. Peter Bruce, Andrew Bruce, Peter Gedeck, 'Practical Statistics for data scientists 50+ Essential Concepts Using R and Python', Orelly, 2nd Edition, 2020.
2. Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, 'Statistics', 2007.
3. S. C. Gupta, V. K. Kapoor, Sultan Chand, 'Fundamentals of mathematical statistics', 10th Edition, 2002.

Web Links:
1. Essentials of Data Science With R Software _ 1: Probability and Statistical Inference, IIT Kanpur: https://nptel.ac.in/courses/111104146
2. Probability and Statistics: https://onlinecourses.nptel.ac.in/noc21_ma74/preview

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MULTIDISCIPLINARY MINOR

Program: B.Tech in Computer Science and Engineering (DataScience)   **Semester: IV**

Course: Web Engineering Laboratory (DJS23DMD251L)

Pre-requisite: Programming Fundamentals

Objectives:

To provide the basic framework of web development (MERN Stack) and cloud computing.

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

1. Develop a website as per the requirements.
2. Apply the concepts of cloud computing to improve the efficiency of web development.
3. Evaluate the requirement of the problem and select appropriate method of web development.

Web Engineering Laboratory (DJS23DMD251L)		
Unit	**Description**	**Duration**
1	**HTML:** 1. Create a static web page using HTML. 2. Create a class timetable using HTML. 3. Create a registration form using HTML. 4. Create a web page using HTML5 tags.	02
2	**CSS:** 1. Design a responsive web page and CSS3 using external CSS (media queries). 2. Design a web page using Bootstrap. 3. Design the admission form using Bootstrap.	02
3	**Client-Side Scripting:** 1. Programs based on objects in JavaScript. 2. Programs based on form validation. 3. Fetch Data from an API Using the Fetch API in JavaScript.	06
4	**React JS:** 1. Types of Components 2. Single Page Application (Virtual DOM) 3. State 4. React Hooks	08
5	**Introduction to Git and GitHub:** 1. Adding files to the staging area 2. Push new branch 3. Merge into the master 4. Auto Commit	02
6	**Server-Side Scripting:** 1. Installation and Configuration of Node.js server 2. Program based on inbuilt functions in Node.js	04
7	**Express & MongoDB:** 1. Using Mongoose to make schemas in MongoDB. 2. Making API end points using Express and testing using postman. 3. Develop a website and integrate it with pre-defined API.	08

	4. Doing CRUD on database MongoDB using Express. 5. PostgreSQL & Sequelize	
8	**XML & XSL:** 1. Design XML using XML DTD and schema. 2. Implementing XSL elements in XML. 3. Validate XML using Node.js	04
9	**Concepts of Cloud Computing:** 1. Introduction to cloud computing. 2. NIST model 3. Service and Deployment models.	04
10	**Networking and Security:** 1. Identity and Access Management 2. Networking basics 3. VPC networking and security 4. Design a VPC 5. Build your own VPC and Launch a Web Server	04
11	**Compute Service:** 1. Compute Services overview 2. Elastic Computing 3. Serverless Compute service 4. Deploying and scaling web applications	04
12	**Storage Service:** 1. Cloud object storage 2. Cloud block storage 3. Elastic file system	04
13	**Database Service:** 1. Cloud Relational database services 2. Cloud NoSQL Databases 3. Elastic load balancing	04
	Total	**56**

*The Term Work will be calculated based on Laboratory Performance (15m), Mini Project (10m) and Computer Based Assessment (25m).

Books Recommended:

Text books:

1. Vasan Subramanian, Pro MERN Stack, 2nd Edition, Apress Publication, 2019.
2. Shama Hoque, Full-Stack React Projects, 2nd Edition, Pac kt Publication, 2020
3. Rajkumar Buyya, James Broberg, Goscinki Cloud Computing: Principles and Paradigms, Wiley, 2013.
4. Shalabh Aggarwal, Flask Framework Cookbook: Over 80 proven recipes and techniques for Python web development with Flask, Packt publication, 2nd Edition, 2019.

Reference Books:

1. Benjamin LaGrone, HTML5 and CSS3 Responsive Web Design Cookbook, 1st Edition, Packt Publishing, 2013.

2. DT Editorial Services, Web Technologies: Black Book, 1st Edition, Dreamtech Press, 2018.

3. Christopher Schmitt, Kyle Simpson, HTML5 Cookbook, 1st Edition, O'Reilly Media Inc., 2011.

4. Uttam K. Roy, Web Technologies, 1st Edition, Oxford University Press, 2010.

5. Greg Sidelnikov, React. Js Book: Learning React JavaScript Library from Scratch, 1st Edition, Independently Published, 2017.

6. DT Editorial Services, HTML5 Black Book, 2nd Edition, Dreamtech Press, 2016.

7. Ben Frain, Responsive Web Design with HTML5 and CSS3, 2nd Edition, Packt Publishing, 2015.

8. Steve Suehring, JavaScript Step by Step, 3rd Edition, Pearson Education, 2013.

9. Stoyan Stefanov, React Up Running Building Web Applications, 1st Edition, O'Reilly Media Inc., 2016.

10. Velte, Cloud Computing a Practical Approach, Tata McGraw-Hill Education.

11. Sandip Bhowmik, Cloud Computing, Cambridge University Press, 2017.

12. Miguel Grinberg, Flask Web Development, O'Reilly publication,2018

13. Sack Stouffer Daniel Gaspar, Mastering Flask Web Development, Packt Publication, 2018

Web Links:
1. Professional and Lifelong Learning: Web Development Courses | Harvard University
2. Virtual Lab: https://html-iitd.vlabs.ac.in/exp/introduction-to-html/references.html

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OPEN ELECTIVE

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.

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

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.

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

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	12

	method steepest ascent (descent) method — Newton's method.	
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.

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

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Corporate Finance Management (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 (DJS23XOE264)		
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.:	08

	Working Capital Management: Concepts of Meaning Working 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.

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

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Corporate Social Responsibility (DJS23XOE265)		

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.

Corporate Social Responsibility (DJS23XOE265)		
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**	09

		Market based pressure and incentives, civil society pressure, the regulatory environment in India Counter trends, Review of current trends and 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/

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

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 (DJS23XOE266)		
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

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 (DJS23XOE267)		
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 (DJS23XOE268)		
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.

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

Shri Vile Parle Kelvani Mandal's

DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

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 (DJS23XOE269)		
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	**09**

	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.	
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

ABILITY ENHANCEMENT COURSE

Program: Common to all Programs   **Semester: IV**

Course: Professional and Business Communication Tutorial (DJS23XHS281T)

Course Objectives:
1. To inculcate professional and ethical attitude at the workplace
2. To enhance communication and interpersonal skills
3. To develop effective employability skills
4. To hone written skills for technical documentation

Outcomes: On completion of the course, the learner will be able to:
1. Apply group discussion techniques in professional situations
2. Use employability skills to optimize career opportunities
3. Employ storytelling techniques for effective presentation
4. Prepare technical documents using appropriate style, format, and language
5. Analyze the concept of professional ethics
6. Demonstrate interpersonal skills in professional and personal situations

Professional and Business Communication Tutorial (DJS23XHS281T)
The course is designed to equip students with essential skills, crucial for navigating the contemporary job market successfully and fostering a positive work environment through effective communication and collaboration. The assignments comprise of a combination of interactive activities, discussions, case studies and real-world simulations, to help students, not only to ace job interviews and professional interactions, but also to contribute positively to the ethical and productive functioning of any organization. For the project work, students must prepare and present a well-researched and persuasive business proposal, in groups, integrating the skills and knowledge acquired throughout the course.

Unit	Description of Tutorial Activities	No of Assignments
1	**Group Discussion:** Purpose of a GD, types of GD, criteria for evaluating GD, Dos and Don'ts of GD **Activity:** *The students will be divided into groups of 8-12 and each group will be given a topic/case to discuss within a given time frame. Each student will submit a write-up on their observations of the GD.*	1
2	**Employment Skills** **Resume Writing:** Types of resumes, structure, content, and formatting of resume **Activity:** *The students will prepare and submit their individual resume according to the professional requirements.* **Interview Skills:** Types and modes of interview, Preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview **Activity:** *The students will submit a write-up on the FAQs and participate in mock interviews*	2
3	**Corporate Story Telling:** Elevator pitch, product stories, event stories, stories in presentations, storytelling in SOPs and interviews, storytelling to manage conflict or to motivate.	1

	Activity: *The students will be divided into groups of 8-12 and asked to give a team presentation using storytelling technique and submit the hardcopy of the ppt.*	
4	**Technical Writing and Documentation** **Business Proposal Writing:** Types of business proposals, format of proposal, language and style, presentation of proposal **Meeting Documentation:** Planning layout of meetings, observing meeting decorum, drafting notice, agenda, and minutes of meeting **Activity:** *The students will be divided into groups of 8-12 and each group will conduct a mock meeting based on an agenda and submit a writeup of the meeting documentation.*	1
5	**Professional Ethics:** Effective work habits, accountability, integrity, and excellence **Activity:** *The students will be divided into groups of 8-12 and each group will analyse a case involving an ethical issue and submit the writeup.*	1
6	**Interpersonal Skills** **Team Building:** Difference between group and team, importance of teamwork, strategies to be a good team player **Activity:** *The students will be divided into groups of 8-12 and each group will be assigned a task to be accomplished as a team, for which they will submit the writeup.* **Leadership:** Types of leadership, leadership styles, case studies **Activity:** *Each student will submit a writeup involving a leader they admire, analysing various aspects of his leadership style.* **Time Management:** Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goals **Activity:** *Each student will submit a writeup about a case involving time management.*	2

Batch wise tutorial work of minimum eight assignments from the above suggested list or any other assignments based on the syllabus will be included, which would help the learner to apply the concepts learnt.

Books Recommended:
1. Fred Luthans, *"Organizational Behavior",* McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business",* McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication",* McGraw Hill
4. Wallace and Masters, *"Personal Development for Life and Work",* Thomson Learning, 12th edition
5. Heta Murphy*, "Effective Business Communication",* Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing",* Tata McGraw-Hill   Education
7. Ghosh, B. N., *"Managing Soft Skills for Personality Development",* Tata McGraw Hill. Lehman,
8. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
9. Dr. Alex, K.," Soft Skills", S Chand and Company

10. Subramaniam, R., "Professional Ethics" Oxford University Press.
11. Sandeep Das, "How Business Story Telling Works: Increase Your Influence and Impact" Penguin Random House India Pvt. Ltd.

Evaluation Scheme:
Continuous Assessment (A):
Term Work: - 50 marks.
Term Work shall comprise of:
Minimum 8 assignments: 25 marks.
Business Proposal presentation: 15 marks.
Group Discussion: 10 marks.

Prepared by   Checked by   Head of the Department   Principal

ENTREPRENEURSHIP / ECONOMICS / MANAGEMENT COURSES

Program: Common to all Programs.   **Semester: IV**

Course: Economics and Financial Management (DJS23XHS282)

Pre-requisite: Knowledge of Economics and Finance domain current affairs.

Objectives:
1. To describe the relationships among variables to analyse economic issues.
2. To Explain the function of the market and prices as an allocative mechanism.
3. To identify key macroeconomic indicators and measures of economic change, growth, and development
4. To understand basic concepts of financial management and their application in investment and financing decisions
5. To explore the relationship between Financial Management and Financial Statements.

Outcomes: On completion of the course, learner will be able to:
1. Analyse individual decision making, how prices and quantities are determined in product and factor markets, microeconomic and macroeconomic outcomes
2. Analyse the performance and functioning of government, RBI, markets, and institutions in the context of social and economic problems.
3. Analyse the current economic status of India at global levels and provision in budget to address economic issues at national level.
4. Describe an understanding of the overall role and importance of the finance function.
5. Analyse financial performance and make appropriate inferences.

Economics and Financial Management (DJS23XHS282)		
Unit	Syllabus Content	Hours
1	**Introduction to Economics** Fundamentals of Economics, Definition and scope of economics, the nature of the economic problem, finite resources and unlimited wants, definitions of the factors of production and their rewards, definition of opportunity cost, the influence of opportunity cost on decision making. **Microeconomics and Macroeconomics** The role of markets in allocating resources, the market system, introduction to the price mechanism, Demand, Supply and Price determination, Price elasticity of demand and supply (PED).	06
2	**Role of Government and RBI** Money, Banking, Households, Firms, economies and diseconomies of scale, Market Structure, Fiscal Policy, Monetary Policy, Economic Growth, causes and consequences of recession, causes of economic growth, measurement of economic growth inflation and deflation, living standards, indicators of living standards.	04

3	**Government Policies** Last 20 years Journey of Indian Economy, Measures taken to grow Indian Economy, Meaning of India is the world's fifth-largest economy by nominal GDP and the third-largest by purchasing power parity (PPP), On a per capita income basis, India ranked 139th by GDP (nominal) and 127th by GDP (PPP) (Data reference year 2023), Comparison of top 5 largest economies in world, Discuss key points of India latest union budget and its impact on Indian economy and citizens, Meaning of Initiatives like Make in India, Digital India, Skill India etc. and expected impact on Indian Economy		04
4	**Overview of Financial Management** Fundamentals of financial management, principles and functions of the financial management, Strategy, methods, and techniques of the financial management, Overview of financial instruments, financial markets, financial Institutions		04
5	**Overview of Financial Statements** Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios;		10
		Total	28

Books Recommended:

Text books:
1. Gaurav Datt & Biswajit Nag, "Datt & Sundharam's Indian Economy", S. Chand Publications, 73rd Edition, 2024.
2. Prasanna Chandra, "Fundamentals of Financial Management", McGraw Hill Publications, 7th Edition, 2020.

Reference Books:
1. Public Economics: The Macroeconomic Perspective by Burkhard Heer, Springer International Publications,2019
2. Indian Economy: Economic Ideas, Development, and Financial Reforms by Raj Kumar Sen, Deep & Deep Publications, 2008
3. Indian Economy: Performance and Policies by Dr. V. C. Sinha, SBPD Publications,2021
4. Financial Management by C. Paramasivan, T. Subramanian, New Age Publications,2009
5. Financial Management Practices in India by Sandeep Goel, Taylor & Francis 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   Principal

VOCATIONAL AND SKILL ENHANCEMENT COURSE

Program: B.Tech in Computer Science and Engineering (Data Science)   Semester: IV

Course: Innovative Product Development II (DJS23XSC251P)

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.

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 also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide input to students during the entire span of the activity, spread over 2 semesters, wherein the 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, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, 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 yearlong course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e., during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by a panel of faculty members. 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. Revisiting the proposed solution
  ii. System Design and Specification
  iii. Presentation Quality
  iv. Contribution as a team member and Punctuality

Review 2:
  i. Implementation Details & Status (30% project implementation)
  ii. Design & System Specifications
  iii. Presentation Quality
  iv. Contribution as a team member and Punctuality
  v. Project Documentation

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.

- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal Examiners.

Prepared by   Checked by   Head of the Department   Principal