Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and Detailed syllabus (DJS22)

Final Year B.Tech

in

Computer Science and Engineering (Data Science)

(Semester VIII)

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme of Semester VIII (DJS22) 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					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 Total (TT1 + TT2)	Term Work	CA Total (B)			
1	DJS22DSC801	Data Ethics	2	--	--	2	2	65	--	--	--	65	20	15	35		35	**100**	2	**3**
	DJS22DST801	Data Ethics Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	**25**	1	
2	DJS22DSC802	High Performance Computing	3	--	--	3	2	65	--	--	--	65	20	15	35		35	**100**	3	**4**
	DJS22DSL802	High Performance Computing Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
3@	DJS22DSC8011	Quantum Computing	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	**4**
	DJS22DSL8011	Quantum Computing Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	**25**	1	
	DJS22DSC8012	Social Network Analysis	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22DSL8012	Social Network Analysis Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	**25**	1	
	DJS22DSC8013	Robotics and AI	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22DSL8013	Robotics and AI Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	**25**	1	
	DJS22DSC8014	Applied Game Theory	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22DSL8014	Applied Game Theory Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	**25**	1	
4#	DJS22ILO8021	Project Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	**3**
	DJS22ILO8022	Entrepreneurship Development and Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8023	Corporate Social Responsibility	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8024	Human Resource Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8025	Corporate Finance Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8026	Logistic and Supply Chain Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8027	IPR and Patenting	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8028	Digital Marketing Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8029	Environmental Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
	DJS22ILO8030	Labour and Corporate Law	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	**100**	3	
5	DJS22DSP803	Project Stage - II	--	10	--	5	2	--	--	--	100	100	--	--	--	100	100	**200**	5	**5**
6	DJS22A4	Disaster Management and Preparedness	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		Total	**13**	**14**	**1**	**19**	**10**	**260**	**0**	**0**	**100**	**360**	**80**	**60**	**140**	**175**	**315**	**675**	**19**	**19**

@Any 1 Department Elective
#Any 1 Institute Level Elective

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
Theory	a. One Term test (based on 40 % syllabus)	20	1
	b. Second Term test (next 40 % syllabus) / presentation / assignment / course project / group discussion / any other.	15	1
	Total marks of a and b	35	--
Audit course	Performance in the assignments / qui / 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.	65	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

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Computer Science and Engineering (Data Science)

(Semester VIII)

Final Year B.Tech. (DJS22)

Programme Core Courses

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

Course: Data Ethics (DJS22DSC801)

Data Ethics Tutorial (DJS22DST801)

Pre-requisite: Fundamentals of Data Analysis**,** Machine Learning

Objectives: To enable students to understand and apply ethical principles in data-driven technologies through the concepts of fairness, privacy-preserving learning, explainable AI, and responsible governance.

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

1. Identify data privacy, security, bias and accountability issues in real world problem.
2. Apply different concepts of Data Ethics to solve real world problem.
3. Analyse model transparency in the field of data science.
4. Design ethical governance strategies and assess the broader social impact of AI and data systems.

Data Ethics (DJS22DSC801)		
Unit	**Description**	**Duration**
1	**Foundations of Data Ethics and Responsible AI:** What is data ethics and why it matters in data science, Historical and philosophical background (autonomy, beneficence, justice, non-maleficence), Ethical theories (consequentialism, deontology, virtue ethics), Responsible AI and the data lifecycle **Case study: Cambridge Analytica and Facebook**	**5**
2	**Data Privacy and Security:** Data privacy concepts and challenges in centralized systems, Informed consent, anonymization, and user data rights, Global privacy laws: GDPR, HIPAA, CCPA, DPDP **Introduction to Federated Learning (FL):** Decentralized training and its privacy advantages, Ethical issues in FL: data leakage, model inversion, ownership, **Case study: Google's Federated Learning for mobile devices**	**7**
3	**Fairness, Bias, and Accountability in Machine Learning:** Types and sources of bias (sampling, labeling, algorithmic), Fairness metrics in AI (demographic parity, equal opportunity), Detecting and mitigating bias in datasets and models, Algorithmic accountability and auditability **Case study: Bias in the COMPAS recidivism prediction system**	**6**
4	**Transparency, Explainable AI (XAI), and Ethical Model Interpretability:** Importance of transparency and trust in AI systems, Explainable AI (XAI): concepts, tools, and methods (LIME, SHAP, Grad-CAM), Ethical challenges in black-box AI models, Balancing accuracy vs. explainability, Regulatory importance of explainability (EU AI Act, IEEE Standards) **Case study: Explainability in medical AI diagnosis**	**6**

5	**Governance, Emerging Issues, and Future Directions:** Ethical data governance and stewardship, AI ethics frameworks (OECD, EU, UNESCO, IEEE), Societal and environmental impact of AI (energy use, carbon footprint), Digital divide, inclusion, and global data justice, Emerging ethical issues: generative AI, misinformation, deepfakes **Student capstone: develop an ethical policy for a data science project**	**4**
	Total	**28**

Data Ethics Tutorial (DJS22DST801): One activity under every tutorial needs to be carried out.	
Tut.	**Suggested Tutorials**
1	**Introduction to Data Ethics through Case Analysis** **Activities:** Case study discussion: Facebook–Cambridge Analytica. Group debate: "Should social media data be used for political profiling?" Group Discussion : Autonomy, beneficence, and justice.
2	**Ethical Frameworks and Decision-Making Models** **Activities:** Compare decisions using three ethical frameworks. Ethical dilemma simulation: "AI system denies loan applications based on demographic data.
3	**Privacy and Data Protection in Practice** **Activities:** Discussion: GDPR, HIPAA, and CCPA requirements. Hands-on exercise: Anonymize a small dataset and assess re-identification risks. Case discussion: Google Street View and Privacy.
4	**Federated Learning and Ethical Implications** **Activities:** Hands-on Lab: simple federated averaging using Python or Flower framework. Discussion: advantages and limitations of FL (privacy vs. performance). Case analysis: Google Gboard's Federated Learning implementation.
5	**Identifying Bias in Datasets** **Activities:** Lab exercise: analyze demographic representation in a dataset (e.g., UCI Adult Income dataset) Compute basic fairness metrics (demographic parity). Discussion: implications of biased training data.
6	**Fairness and Accountability in AI Systems** **Activities:** Group debate: "Should fairness always outweigh model accuracy?" Case study: COMPAS Algorithm Bias. Explore bias mitigation strategies using open-source tools (AIF360 or Fairlearn).
7	**Introduction to Explainable AI (XAI)** **Activities:** Discussion on interpretability vs. explainability. Hands-on Lab: LIME and SHAP on a classification model. Discussion: ethics of black-box models.
8	**XAI in High-Stakes Domains** **Activities:** Case study: Explainability in medical diagnosis AI. Compare rule-based and deep learning models for interpretability. Discuss "right to explanation" in EU AI Act.
9	**Trade-offs in Explainability and Ethics** **Activities:** Group experiment: manipulate explanations using different model parameters. Discussion: when might too much transparency cause harm? (e.g., gaming the model).

10	**Ethical Governance and Policy Frameworks** **Activities:** Review documents: OECD, UNESCO, and EU AI Ethics Guidelines. Discussion: compare three frameworks on fairness and accountability.
11	**Emerging Ethical Challenges (Deepfakes, Generative AI)** **Activities:** Discussion: ethics of deepfakes, misinformation, and LLMs (ChatGPT, Midjourney). Analyze recent AI ethics controversies (e.g., OpenAI, Stability AI). Brainstorm ethical safeguards for generative models.
12	**Capstone Project Presentation and Ethical Review** **Activities:** Student project presentations: develop an ethical audit or policy for a chosen AI system. Peer review session and panel feedback. Reflection on personal data ethics values.

The Term Work will be calculated based on Tutorial Performance (15m) and Assignments/Quizzes (10m).

Books Recommended:

Textbooks:

1. Christoph Stückelberger, Pavan Duggal, Data Ethics: Building Trust: How Digital Technologies Can Serve Humanity, Globethics Publications, 1st Ediiton, 2023.
2. Gry Hasselbalch & Pernille Tranberg, Data Ethics, PubliShare, Kindle Edition.
3. Christoph Molnar, Interpretable Machine Learning, 2022.
4. Explainable AI: Foundations and Practical Techniques - Paresh Patil, Sushant Gaikwad, Akash Hatkangane (Walnut Publication, 2024)
5. Federated Learning: Decentralized Machine Learning for Privacy and Security by Lavanya Arora, Kindle Edition.

Reference Books:

1. Ian Foster, Rayid Ghani, Ron S. Jarmin, Frauke Kreuter, Julia Lane, Big Data and Social Science: Data Science Methods and Tools for Research and Practice, Chapman and Hall/CRC, 2nd Edition, 2020.
2. Evren Eryurek, Uri Gilad, Valliappa Lakshmanan, Data Governance: The Definitive Guide - People, Processes, and Tools to Operationalize Data Trustworthiness, Shroff/O'Reilly, 1st Edition, 2021.
3. Bonawitz et al., Federated Learning: Collaborative Machine Learning without Centralized Training Data, Google AI Blog.

Web Links:

1. Ethics in Data Science: https://www.analyticsvidhya.com/blog/2022/02/ethics-in-data-science- and-proper-privacy-and-usage-of-data/
2. Business Insights Harvard: https://online.hbs.edu/blog/post/data-ethics
3. Data Science Professionals: https://emeritus.org/blog/data-science-and-analytics-data-science- course-curriculum/
4. Federated Learning in Practice: Google AI Blog : https://research.google/blog/federated-learning-with-formal-differential-privacy-guarantees/
5. Explainable AI Principles: IBM Research Blog : https://research.ibm.com/blog/ai-explainability-360

Frameworks and Guidelines

1. EU AI Act (2024 draft) - Requirements for transparency and accountability.
2. OECD AI Principles (2019) - Human-centered values and fairness.
3. IEEE (2022). Ethically Aligned Design, Version 2

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

Course: High Performance Computing (DJS22DSC802)

High Performance Computing Laboratory (DJS22DSL802)

Pre-requisite: Parallel Computing, Distributed Computing

Objectives:

- This course in High-Performance Computing (HPC) for Data Science with an emphasis on GPU parallel computing introduces students to the fundamental concepts and practical skills necessary for harnessing the power of Graphics Processing Units (GPUs) in data-intensive computations.
- Throughout the course, students will explore GPU architecture, CUDA programming, memory optimization techniques, parallel programming patterns, and performance optimization strategies.
- They will also delve into advanced topics like GPU-accelerated libraries and the integration of GPUs with popular data science frameworks. By the end of this course, students will be equipped to leverage GPU parallel computing to significantly enhance the efficiency and performance of data science applications.

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

1. Explain the architecture of modern GPUs, CUDA programming model, and parallel programming challenges.
2. Implement CUDA C programs to solve data parallelism problems and use CUDA memory models effectively.
3. Analyze GPU performance metrics, including memory coalescing, thread scheduling, and control divergence impacts.
4. Assess different GPU computing frameworks and libraries (cuBLAS, cuDNN) based on application requirements and efficiency.

High Performance Computing (DJS22DSC802)		
Unit	**Description**	**Duration**
1	**Introduction to Heterogeneous Parallel Computing** **Introduction:** Architecture Of A Modern GPU, Challenges In Parallel Programming, Parallel Programming Languages And Models **Data Parallelism**: Data Parallelism, CUDA C Program Structure, A Vector Addition Kernel, Device Global Memory And Data Transfer, Kernel Functions And Threading, Kernel Launch	**8**
2	**CUDA Parallelism Model** **Scalable Parallel Execution:** CUDA Thread Organization, Mapping Threads To Multidimensional Data, Synchronization And Transparent Scalability, Resource Assignment, Thread Scheduling And Latency Tolerance **Memory And Data Locality:** CUDA Memories, Tiled Parallel Algorithms, Tiled Matrix Multiplication, Tiled Matrix Multiplication Kernel, Boundary Checks, Memory As A Limiting Factor To Parallelism	**8**
3	**Performance Considerations On GPUs** **Memory Access Performance:** Global Memory Bandwidth, Memory Coalescing in CUDA, Channels and Banks in Dram Systems, Techniques For	**8**

	Reducing Memory Transfers Between CPU And GPU. **Thread Execution Efficiency:** Warps And SIMD Hardware, Dynamic Partitioning Of Resources, Performance Impact Of Control Divergence	
4	**Parallel Computation Patterns** **Parallel Patterns: Convolution:** 1d Parallel Convolution- A Basic Algorithm, Constant Memory and Caching, Tiled 1d Convolution with Halo Cells, A Simpler Tiled 1d Convolution- General Caching **Parallel Computation Patterns (Histogram):** Atomic Operations In Cuda, Atomic Operation Performance-Block versus Interleaved Partitioning, Latency versus Throughput of Atomic Operations, Atomic Operation in Cache Memory, Privatization Technique For Improved Throughput	**8**
5	**Efficient Host-Device Data Transfer** Pinned Host Memory, Task Parallelism in CUDA, Overlapping Data Transfer with Computation, CUDA Unified Memory	**4**
6	**Advanced Topics in GPU Computing:** Introduction to GPU-accelerated libraries (cuBLAS, cuDNN, cuGraph), GPU computing frameworks (TensorFlow, PyTorch) and their integration with GPUs, Introduction to GPU clusters and distributed GPU computing **Application case study- machine learning:** Convolutional Neural Networks, Convolutional Layer: A Basic CUDA Implementation of Forward Propagation, Reduction of Convolutional Layer to Matrix Multiplication, cuDNN Library	**6**
	Total	**42**

High Performance Computing Laboratory (DJS22DSL802)	
Exp.	**Suggested Experiments**
1	Set up the CUDA environment, install the CUDA Toolkit, and write a basic CUDA program to understand the CUDA development environment.
2	Implement vector addition using CUDA to introduce students to parallelism, thread management, and memory allocation in GPU programming.
3	Develop a CUDA program for matrix multiplication to understand parallelism and optimization techniques in GPU computing.
4	Apply CUDA for image processing tasks, like blurring and edge detection, to learn how to process images efficiently using GPU parallelism.
5	Implement parallel reduction operations (e.g., sum, min, max) to grasp the concept of efficient parallel reduction.
6	Explore parallel sorting algorithms using CUDA, comparing their performance with CPU-based sorting and optimizing CUDA sorting.
7	Employ CUDA to perform a Monte Carlo simulation for estimating mathematical constants or solving real-world problems to understand the power of GPU parallelism.
8	Experiment with CUDA to implement concurrent data structures using locks and atomic operations to learn how to manage data concurrently.
9	Optimize the reduction step in machine learning algorithms using CUDA, focusing on techniques for efficient large-scale data processing.
10	Integrate CUDA-accelerated code with data science frameworks like TensorFlow or PyTorch to develop and run GPU-accelerated machine learning models for practical applications.

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 Assignments (10m).

Books Recommended:

Text Books:

1. Georg Hager, Gerhard Wellein, “Introduction to High Performance computing for Scientist and Engineers”, CRC press, 2019.
2. Duane Storti and Mete Yurtoglu, "CUDA for Engineers”, Addison-Wesley,1st Edition, 2016.

Reference Books

1. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", Morgan Kaufmann, 2nd Edition, 2012.
2. Charles Severance and Kevin Dowd, "High Performance Computing" , O'Reilly Media, 2nd Edition, 1998.
3. Jason Sanders and Edward Kandrot , "CUDA by Example: An Introduction to General-Purpose GPU Programming" , Addison-Wesley, 2010.
4. NVIDIA Corporation , "GPU Gems", Addison-Wesley
5. Gerhard Hager and Markus Hadwiger , "Programming the GPU with CUDA", Springer
6. Brian Tuomanen and Daniel Kim, "Deep Learning with CUDA", O'Reilly Media

Web links:

1. HPC: https://archive.nptel.ac.in/courses/106/105/106105033/.
2. HPC Springer Journal: https://link.springer.com/book/10.1007/978-3-030-13325-2.
3. Programming Model: https://homepage.physics.uiowa.edu/~ghowes/teach/phys5905/lect/NumLec11_IntroHPC.pdf.

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Computer Science and Engineering (Data Science)

(Semester VIII)

Final Year B.Tech. (DJS22)

Department Electives

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

Course: Quantum Computing (DJS22DSC8011)
Quantum Computing Laboratory (DJS22DSL8011)

Pre-requisite: Computer System Fundamentals**,** Machine Learning**,** Information Security

Objectives:

- To introduce the basics of Quantum Computing and Quantum state transformation and classical computation versions.
- To understand advanced Quantum Computation Algorithms and basics of Quantum Machine Leaming.

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

1. Analyze fundamental quantum computing concepts such as qubits, quantum states, superposition, entanglement, and basic quantum gates.
2. Apply quantum computation techniques and advanced quantum algorithms to address simple real-world computational problems.
3. Implement basic quantum cryptography protocols and apply quantum machine learning and quantum deep learning techniques using parameterized quantum circuits.

Quantum Computing (DJS22DSC8011)		
Unit	**Description**	**Duration**
1	**Complex Numbers, Vector Space, and Dirac Notation:** Complex Numbers, Complex Conjugation, Vector Space, Basic set, Dirac Notation, Ket and Bra, Inner Product, Linearly Dependent and Independent Vectors, Dual Vector Space, Computational Basis, Outer Product, Spin and Qubit.	**07**
2	**Quantum Computing vs. Classical Computing:** History of quantum computation and quantum information, Quantum State, Bloch sphere, Dense coding, Physical quantum phenomena: Spin, Quantum superposition, Interference and Entanglement. **Logic Gates and Circuits:** Boolean Algebra, Functional Completeness, Gates, Circuits, Universal Gates, Gates and Computation **Quantum Gates and Circuits:** Qubits, The CNOT, Pauli, Hadamard, Toffoli Gates, Quantum Gate, Quantum Gates Acting on one Qubit, No Cloning Theorem, Quantum Computation, Multiple qubit gates, Qubit copying circuit, Example: Bell states, quantum teleportation	**07**
3	**Quantum Computing algorithms:** Classical computations on a quantum computer, Quantum parallelism, Quantum key distribution, Superdense coding, quantum teleportation, applications of teleportation, probabilistic versus quantum algorithms, phase kick-back, Quantum phase estimation and quantum Fourier Transform, eigenvalue estimation, Shor's Factorization Algorithm, Grover's Search Algorithm, Quantum algorithms summarized.	**06**

4	**Quantum Cryptography algorithm:** Cryptography using principles of quantum computing, No-cloning theorem, Quantum key distribution Algorithm, Quantum secret sharing Algorithm.	**05**
5	**Quantum Machine Learning Basic (QML):** Variational Quantum Circuits, Parameterized quantum circuits, Parameterized quantum circuit properties, Entangling capability, Parameterized quantum circuits for machine learning Data encoding Methods, Basis encoding, Amplitude encoding, Angle encoding, Arbitrary encoding, Supervised learning, Quantum variational classification, Quantum kernel estimation, Variational training, Quantum Support Vector Machine (QSVM).	**09**
6	**Quantum Deep Learning (QDL):** Basics of Quantum Neural Networks, Finite difference gradients, Analytic gradients, Natural gradients, Simultaneous Perturbation Stochastic Approximation, Training in practice, exponentially vanishing gradients (barren plateaus), Quantum Convolutional Neural Network.	**08**
	Total	**42**

Quantum Computing Laboratory (DJS22DSL8011)	
Exp.	**Suggested Experiments**
1	Implementing Quantum Programs with the Qiskit SDK.
2	Implementing logic of Quantum Gates and Universal Gates with Qiskit.
3	Implementing a Quantum Random Number Generator with Qiskit.
4	Implementation of Quantum Key Distribution Using the BB84 Protocol with Qiskit on a Quantum Computer.
5	Experimentation with Quantum Teleportation Protocols.
6	Implementation and Analysis of Shor's Algorithm Using Qiskit SDK.
7	Implementation of Quantum key distribution Algorithm.
8	Implementation of Grover's Search Algorithm with Qiskit.
9	Implementation and Exploration of Quantum Machine Learning Techniques: Parameterized Circuits, Data Encoding Methods, and Training Strategies in Qiskit.
10	Implementation of Supervised Strategies in Quantum Machine Learning: Exploring Quantum variational classification. SVM.
11	Implementation of Quantum key distribution Algorithm.

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 (15 marks) and Assignments/Quizzes (10 marks).

Books Recommended:

Textbooks:

1. Parag K. Lala, 'Quantum Computing', McGraw Hill**,** 1st Edition, 2020.
2. Chris Bernhardt, 'Quantum Computing for Everyone', MIT Press, 1st Edition, 2020.

Reference Books:

1. Jack D**.** Hidary, 'Quantum Computing: An Applied Approach', Springer, 2nd Edition, 2021.
2. Johan Vos, 'Quantum Computing in Action', Manning Publications, 1st Edition, 2022.

Web Links:

1. https://qiskit.org/learn
2. https://eleam.nptel.ac.in/shop/iit-workshops/completed/quantum-computing/

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

Course: Social Network Analysis (DJS22DSC8012)
Social Network Analysis Laboratory (DJS22DSL8012)

Pre-requisite: Probability and Statistics, Machine Learning

Objectives: To equip students with the knowledge and analytical skills necessary for the study of massive networks, addressing the associated computational, algorithmic, and modeling challenges, and to cultivate a research-oriented perspective on the structure, dynamics, and analysis of large-scale networks.

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

1. Analyse social networks using visualization techniques and structural measures.
2. Illustrate network growth patterns and ranking methodologies in complex networks.
3. Examine methods for detecting communities, predicting links, and modelling information flow.
4. Apply anomaly detection and representation learning approaches for network analysis.

Social Network Analysis (DJS22DSC8012)		
Unit	**Description**	**Duration**
1	**Society & Network**: Introduction, Use of social networks, defining a network, types of network (link-centric, node and link centric, local view, temporal view, generalization, real-world network), levels of social network analysis, graph visualization tools. **Network Measures**: Network basics, node centrality, assortativity, transitivity and reciprocity, similarity, degeneracy. **Network Growth Models**: Overview of real-world networks and their properties, brief introduction to Erdős-Rényi Random Network Model, Watts-Strogatz Model, and Preferential Attachment Model with their key characteristics and limitations.	**08**
2	**Link Analysis**: Application of link analysis, Signed networks: Balance Theory of Undirected Signed Networks, Status Theory of Signed Networks, Triad Balance vs Status, Strong and Weak Ties: Strength of a Tie, Triadic Closure, Dunbar Number, Local Bridges and Importance of Weak Ties, PageRank, DivRank, SimRank, PathSim.	**07**
3	**Community Detection:** Application of community detection, types of communities, community detection methods, Disjoint Community Detection: Node-centric community detection, modularity and community detection, Overlapping Community Detection: Clique Dynamics, Local Community Detection. **Link Prediction:** Applications of link prediction, Evaluating Link Prediction methods	**07**
4	**Cascade Behaviors & Network Effects:** Preliminaries and Important Terminologies, Cascade Models, Probabilistic Cascades, Epidemic Models, Independent Cascade Models, Cascade Prediction.	**06**
5	**Anomaly Detection in Networks:** Outliers verses network based anomalies. Anomaly in Static Networks: Plain and attributed networks, relational learning, Anomaly in Dynamic Networks: Preliminaries, feature and decomposition-based approaches, Challenges in anomaly detection.	**06**

6	**Graphical Representation Learning:** Intuition behind representation learning**,** representation learning methods. **Graph Convolutional Network (GCN)** and its variations and applications in social network analysis. **Dynamic Graph Convolutional Networks (DGCN) & Continuous-Time Dynamic Graph Neural Networks (CTDGNN):** Advanced models for analyzing evolving social networks	**08**
	Total	**42**

Social Network Analysis Laboratory (DJS22DSL8012)	
Exp.	**Suggested Experiments**
1	Creating and analyzing a graph using Social Network and Gephi Tool.
2	Building a network and network measures using NetworkX: a) Degree & Degree Distribution b) Clustering Coefficients c) Node Centrality Measure
3	Implementation of random scale-free network growth model on network science (Barabási-Albert).
4	Implementation of link analysis using the Random Walk PageRank algorithm.
5	Implementation of link prediction using a classification approach.
6	Implementation of local and global link prediction models.
7	Implement the Clique Percolation Method (CPM) for detecting overlapping communities in a given social network graph.
8	To implement and analyze epidemic models.
9	Implementation of Graph Representation Learning for Social Network Analysis Using GCN.
10	Mini Project

*The term work will be calculated based on Laboratory Performance (15 marks) and Assignments/Quizzes (10 marks).

Books Recommended:

Textbooks:

1. Tanmoy Chakraborty, "Social Network Analysis", First Edition, Wiley, 2021.
2. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, "Analyzing Social Networks", Sage Publications Ltd, 2nd Edition, 2018.
3. William L. Hamilton, "Graph Representation Learning", Morgan & Claypool Publishers,2020.

Reference Books:

1. Xiaoming Fu, Jar-Der Luo, Margarete Boos, 'Social Network Analysis Interdisciplinary Approaches and Case Studies', 1st Edition, CRC Press, 2020.
2. Dr. Krishna Raj P.M., Mr. Ankith Mohan, Dr. Srinivasa K.G, "Practical Social Network Analysis with Python (Computer Communications and Networks)", First Edition, Springer, 2019.
3. John Scott, "Social Network Analysis", Fourth Edition, SAGE Publications Ltd,2017.
4. Song Yang, Franziska Barbara Keller, LuZheng, "Social Network Analysis: Methods and Examples", First Edition, SAGE Publications, 2016.

Web Links:

1. A course on Social Network Analysis
   https://onlinecourses.nptel.ac.in/noc22_cs117/preview
2. Social Network Analysis 101: Ultimate Guide Comprehensive Introduction for Beginners:
   https://visiblenetworklabs.com/guides/social-network-analysis-101/
3. Real-world use cases of Social Network Analysis
   https://www.latentview.com/social-media-analytics/a-guide-to-social-network-analysis-and-its-use-cases/

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

Course: Robotics and AI (DJS22DSC8013)
Robotics and AI Laboratory (DJS22DSL8013)

Pre-requisite: Linear algebra and probability theory

Objectives: To introduce fundamental concepts, kinematics, perception, planning, and control in robotics with an emphasis on data acquisition, machine learning, and autonomous navigation.

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

1. Illustrate the fundamental principles, components, and kinematics of robotic systems.
2. Apply sensor data acquisition, preprocessing, and fusion techniques using Python and ROS.
3. Analyze computer vision, path planning, and SLAM algorithms for perception and navigation.
4. Develop control and decision-making strategies for autonomous robot operation.

Robotics and AI (DJS22DSC8013)		
Unit	**Description**	**Duration**
1	**Introduction to Robotics** Evolution of Robotics, Types of robots – industrial, mobile, humanoid, and autonomous, Components of robotic system (sensing, actuation, control, AI), Types of Sensors – IMU, LiDAR, Camera, GPS, Ultrasonic, Proximity Sensors (Infrared), Vision Sensors, Accelerometers, Gyroscopes, and Encoders (Linear or Rotary), Types of Actuators – Electric (DC, Stepper, Servo Motors), Hydraulic, Pneumatic, and Emerging Smart Actuators (Piezoelectric, Shape Memory Alloy, Electroactive Polymer).	**06**
2	**Robot Kinematics and Motion planning** Coordinate frames and transformations – homogeneous transformation matrices, Forward and inverse kinematics; Denavit–Hartenberg (D–H) parameters, Differential kinematics and Jacobians – conceptual and numerical examples, Configuration space and robot motion representation, Motion planning – introduction, path and trajectory concepts,Types of trajectory planning – Point-to-Point (PTP) and Continuous Path (CP)	**10**
3	**Data Acquisition and Preprocessing** Data collection and preprocessing from multiple sensors through frameworks and middleware (e.g., ROS) for acquisition, synchronization, and refinement of sensor data., Understanding sensor data formats and structures (CSV, JSON, image/video files and ROS bag files). Noise handling using Gaussian, Median, and Kalman filtering methods. Aligning multi-sensor data streams (camera, LiDAR, IMU) using temporal synchronization, spatial calibration, and sensor fusion methods. Handling missing or corrupted data using interpolation, statistical imputation, and smoothing methods, Sensor calibration using intrinsic and extrinsic methods for camera–LiDAR and IMU sensors.	**08**
4	**Robot Perception** Introduction to robot perception and environment understanding, Computer vision in robotics – image acquisition, feature extraction, and object recognition, Application of machine learning and deep learning for perception: Classification using CNN and SVM, Object detection using YOLO and SSD, Image segmentation using U-Net and SegNet, building 3D representations from LiDAR using Voxel Grid Mapping or from stereo vision using SGBM (Semi-Global Block Matching)	**08**
5	**Path Planning** Path planning algorithms –Rapidly exploring Random Tree(RRT), and PRM, Simultaneous Localization and Mapping (SLAM),Components – Localization, mapping, sensor data processing.	**04**

6	**Autonomous Navigation** Types of SLAM – Visual SLAM, LiDAR-based SLAM, RGB-D SLAM, Data association and map building, Learning-based SLAM and navigation using neural implicit mapping and policy learning, Integration of SLAM with path planning and control for autonomous navigation, Evaluation metrics – accuracy, drift, real-time performance, and scalability, Reinforcement Learning for Navigation using Q-Learning, Sim-to-Real Transfer – Domain Randomization, Imitation Learning, Challenges, and Evaluation.	**06**
	Total	**42**

Robotics and AI Laboratory (DJS22DSL8013)	
Sr. No	**Suggested Experiments**
1	Install and explore ROS or Webots; visualize a simple robot model.
2	Simulate a robotic arm and perform forward and inverse kinematics using Python or MATLAB.
3	Acquire and preprocess sensor data (camera or LiDAR dataset) using Python.
4	Implement visual feature detection using SIFT or SURF, or deep object recognition using YOLO or MobileNet.
5	Simulate SLAM using ROS or Gazebo datasets
6	Implement EKF-based localization or 2D SLAM using Python
7	Implement an RRT-based path planner in Webots or Gazebo
8	Implement PID control for a mobile robot simulation using Python or Webots.
9	Implement a simple reinforcement learning control policy for navigation or balancing tasks using Python or Webots.
10	Integrate perception, localization, and planning on a simulated robot using TurtleBot or drone simulation.

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

Books Recommended:

Text Books:

1. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, “Introduction to Autonomous Mobile Robots”, 3rd Edition, MIT Press, 2022.
2. Peter Corke, “Robotics, Vision and Control: Fundamental Algorithms in Python”, 3rd Edition, Springer, 2023.
3. Jonathan Cacace, “Ultimate Robotics Programming with ROS 2 and Python”, 1st Edition, 2024.

Reference Books

1. Mohamed M. Atia, “Sensor Fusion Approaches for Positioning, Navigation, and Mapping: How Autonomous Vehicles and Robots Navigate in the Real World with MATLAB Examples”, 1st Edition, Springer, 2025.
2. Christoph Bartneck, Tony Belpaeme, Friederike Eyssel, Takayuki Kanda, Merel Keijsers & Selma Šabanović, “Human-Robot Interaction – An Introduction”, 2nd Edition, Cambridge University Press, 2024.
3. Larry T. Ross, Stephen W. Fardo & Michael F. Walach, “Industrial Robotics Fundamentals”, 4th Edition, Jones & Bartlett Learning, 2023.

Web Links:

1. https://swayam.gov.in/nc_details/NPTEL (Introduction to Robotics by IIT Madras and Robotics by IIT Kharagpur)
2. https://www.udemy.com/course/robotics-course/
3. https://www.coursera.org/courses?query=robotics

Prepared by Checked by Head of the Department Principal

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

Course: Applied Game Theory (DJS22DSC8014)

Applied Game Theory Laboratory (DJS22DSL8014)

Pre-requisite: Linear Algebra, Calculus, Probability, Statistics and Basic algorithm design and analysis.

Objectives: To understand how individuals and groups make strategic decisions in competitive and cooperative situations, using mathematical models and algorithms to analyze, predict, and optimize outcomes in real-world scenarios such as economics, AI, and multi-agent systems.

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

1. Analyze strategic, zero-sum, and non-zero-sum games to identify Nash equilibria and optimal strategies.
2. Apply algorithmic techniques and reinforcement learning to compute equilibria and model multi-agent interactions.
3. Evaluate evolutionary, cooperative, and Bayesian game scenarios for fairness, stability, and decision-making efficiency.

Applied Game Theory (DJS22DSC8014)		
Unit	**Description**	**Duration**
1	**Introduction to Game Theory:** Strategic games, players, strategies, payoffs; dominance, minimax, saddle points; pure & mixed strategy Nash equilibria; real-world examples: auctions, pricing, simple multi-agent interactions	**04**
2	**Zero-Sum and Non-Zero-Sum Games** Zero-sum games, saddle points, matrix games; mixed strategies; non-zero-sum games, iterated elimination of dominated strategies; Lemke–Howson algorithm.	**05**
3	**Evolutionary and Cooperative Game Theory** Evolutionarily Stable Strategies (ESS), replicator dynamics, fictitious play; cooperative games: transferable utility, core, Shapley value, nucleolus; correlated equilibria; Multi-Agent Reinforcement Learning (MARL) and reward shaping with human feedback.	**08**
4	**Bayesian and Algorithmic Game Theory** Bayesian games, Bayes–Nash equilibrium, auctions, bilateral trading; complexity of equilibrium computation; mechanism design basics; Vickrey auction, incentive-compatible resource allocation.	**08**
5	**Repeated and Extensive Form Games** Repeated games: Nash Folk Theorem, subgame perfect equilibrium, one-shot deviation principle; extensive form games: game trees, backward induction, sequential equilibria	**07**
6	**Game Design, Simulation, and Real-World Applications** Game design principles: payoff engineering, fairness, multiplayer dynamics; applications: oligopoly models, voting games, matching markets, resource allocation, utility theory; RL-based strategy optimization and human-in-the-loop feedback	**10**
	Total	**42**

Applied Game Theory Laboratory (DJS22DSL8014)	
Exp.	**Suggested experiments**
1	Strategic-Form Games and Payoff Matrix Construction: Construct and simulate matrix games; compute best responses and pure Nash equilibria.
2	Dominance Analysis and Mixed Strategy Nash Equilibria: Analyse dominance relations, compute mixed strategies, and visualize payoffs.
3	Zero-Sum Game Simulation and Minimax / Saddle Points: Implement zero-sum games and compute saddle points using Python.
4	Non-Zero-Sum Game Simulation and Iterated Elimination of Dominated Strategies: Solve non-zero-sum games computationally and identify NE.
5	Lemke–Howson Algorithm Implementation: Compute Nash equilibria of bimatrix games algorithmically.
6	Evolutionarily Stable Strategies (ESS) and Replicator Dynamics: Simulate population dynamics and ESS in multi-agent systems.
7	Fictitious Play and Multi-Agent Reinforcement Learning (MARL): Implement learning strategies for repeated interactions and observe convergence.
8	Cooperative Game Theory: Core, Shapley Value, Nucleolus Computation: Compute fair allocations in transferable utility games.
9	Bayesian Games and Bayes–Nash Equilibrium: Implement games with incomplete information and compute equilibria.
10	Auction Simulation: First-Price, Second-Price, Sealed-Bid, and Online Auctions; Analyse strategy and outcomes.
11	Repeated and Extensive Form Games: Simulate repeated strategies, subgame-perfect equilibrium, and backward induction in game trees.
12	Matching Market and Resource Allocation Applications: Implement market design, matching, and allocation scenarios computationally.
13	Custom Game Design with RL and Human-in-the-Loop Feedback: Design a multi-agent game, implement RL agents, incorporate human feedback, and analyse strategic outcomes.

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

Books Recommended:

Text Books:

1. Game Theory: An Introduction, 3rd Edition by E.N. Barron, Wiley, 2024.
2. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT Press, 2nd Edition, 2022.
3. Binmore, K., Game Theory: A Very Short Introduction, OUP, 2010

Reference Books:

1. Shoham Y., Leyton-Brown K., Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press, 2024
2. Thomas Ferguson, Game Theory, World Scientific, 2018

Weblinks:

1. NPTEL Course: https://nptel.ac.in/courses/106105237
2. IIT Bombay: Useful Lecture Notes on Game Theory | IEOR @ IIT Bombay

Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Computer Science and Engineering (Data Science)

(Semester VIII)

Final Year B.Tech. (DJS22)

Institute Level Electives

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Project Management (DJS22ILO8021)		

Pre-requisites: 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, learners will be able to:

1. Explain the project management life cycle and the various project phases, as well as the role of the project manager.
2. Apply selection criteria and select an appropriate project from different options.
3. Create a work breakdown structure for a project and develop a schedule based on it. Manage project risk strategically.
4. Use the Earned Value technique and determine & predict the status of the project.
5. Capture lessons learned during project phases and document them for future reference.

Project Management (DJS22ILO8021)		
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 organizational structures, PM knowledge areas as per the Project Management Institute (PMI).	**8**
2	**Initiating Projects:** How to get a project started, selecting a project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating a charter, Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	**8**
3	**Project Planning:** Work Breakdown Structure (WBS) and linear responsibility chart, Project cost estimation and budgeting, top-down and bottom-up budgeting. Networking and Scheduling techniques, PERT, CPM, Crashing project time, Resource loading and levelling, Goldratt's critical chain, GANTT chart, Project Stakeholders and Communication plan, Introduction to Project Management Information System (PMIS). 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.	**10**
4	**Monitoring and Controlling Projects:** Planning, monitoring, and controlling cycle, Information needs and reporting, engaging all stakeholders of the projects, communication, and project meetings. With Earned Value Management techniques for measuring the value of work completed, using milestones for measurement, change requests, and scope creep, Project audit. Project Contracting Project procurement	**8**

	management, contracting and outsourcing.	
5	**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.	**8**
	Total	**42**

Books Recommended:

Text books:

- Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India.
- Project Management: The Managerial Process, 6th edition, Erik Larson, Clifford Gray, McGraw Hill Education.

Reference Books:

- A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed. Project
- Management Institute PA, USA.
- Project Management, Gido Clements, Cengage Learning.
- Project Management, Gopalan, Wiley India.
- Project Management, Dennis Lock, 9th Edition, Gower Publishing England.

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Entrepreneurship Development and Management (DJS22ILO8022)		

Objectives:

1. To develop entrepreneurial abilities by providing background information about support systems, skill sets, financial and risk covering institutions.
2. To appraise the students with the fundamentals that can help them make the right decisions for.

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

1. Develop idea generation, creative and innovative skills
2. Prepare a Business Plan
3. Compare different entrepreneur-supporting institutions
4. Correlate a suitable MSME scheme for an entrepreneur
5. Interpret the financial and legal aspects of a business.

Entrepreneurship Development and Management (DJS22ILO8022)		
Unit	**Description**	**Duration**
1	**Meaning of Entrepreneur** Evolution of the concept, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur- an emerging class, Concept of Entrepreneurship, Evolution of Entrepreneurship Development of Entrepreneurship Entrepreneurial, Culture Stages in the entrepreneurial process: Develop idea generation, creative, and innovative skills	**08**
2	**Business Planning Process** Meaning of business plan, Business plan process, Advantages of business planning Marketing plan, Production/operations plan, Organization plan, Financial plan, Final Project Report with Feasibility Study, Preparing a model project report for starting a new venture.	**08**
3	**Institutions Supporting Entrepreneurs:** Small industry financing in developing countries, A brief overview of financial institutions in India, Central level and state level institutions - SIDBI-NABARD-IDBI-SIDCO, Indian Institute of Entrepreneurship System. District Industries Centers - Single Window	**08**
4	**Micro, Small, and Medium Enterprises (MSMES):** MSMEs - Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes, Forms of Business; Make-In India, Start-Up India, Stand-Up India. Women Entrepreneurship; Rural Entrepreneurship; Family Business and First-Generation Entrepreneurs	**09**
5	**Finance, Accounting, Costing, and Legal Aspects of Business:** Funding new ventures: Conventional Source of Finance, bootstrapping, crowd sourcing- angel investors, VCs, debt financing, due diligence, Legal aspects of business (IPR, GST, Labour law)- Cost, volume, profit, and break-even analysis - Margin of safety and the degree of operating leverage. Capital budgeting for comparing projects or opportunities, Product costing- Product pricing- Introduction to financial statements - Profit & Loss statement, Balance sheet - Cash flow-Closure of Business	**09**
	Total	**42**

Books Recommended:

Reference Books:

- Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and
- Organization - by Robert D. Hisrich Veland Ramadani, Springer Publication (2017)
- Entrepreneurship-Theory, Process Practice -by Donald F.Kuratko, Cengage Learning(2014)
- Entrepreneurship 6/E-by Robert D. Hisrich McGraw-Hill Education (India) (2011)
- Entrepreneurship and small business- by Burns, P. New Jersey: Palgrave. (2001).
- Innovation and entrepreneurship by Drucker. F. Peter, Harper business, (2006).
- Entrepreneurship development small business enterprises, Poornima M Charantimath Pearson
- Publication (2013)
- Entrepreneurial Development -Jayshree Suresh, Margham Publishers, Chennai
- The Design of Business- by Martin Roger, Harvard Business Publishing (2009)
- Entrepreneurship-by Roy Rajiv Oxford University Press (2011)

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Corporate Social Responsibility (DJS22ILO8023)		

Objectives:

1. To make students understand the concept, theories, and application of CSR for the Development of Society.

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

1. Understand the key characteristics of Corporate Social Responsibility (CSR) in the context of present-day management.
2. Apprise regarding business decision-making, which is informed by ethical values and respect for people, communities, and the environment.
3. Become aware of creating a strategic plan that enables an organization to reach out to its internal and external stakeholders with consistent messages.
4. Understand critical issues of Corporate Social Responsibility (CSR) in a cross-cultural setting.

Corporate Social Responsibility (DJS22ILO8023)		
Unit	**Description**	**Duration**
1	**Introduction to CSR** Meaning and Definition, History of CSR, Concepts of Charity, Corporate Philanthropy, Corporate Citizenship, Sustainability, and Stakeholder Management. Environmental aspects of CSR, Chronological evolution, and Models of CSR in India, including Carroll's model and major codes on CSR Initiatives in India.	**09**
2	**International Framework for Corporate Social Responsibility** Millennium Development Goals, Sustainable Development Goals, Relationship between CSR and MDGs. United Nations (UN) Global Compact 2011. UN guiding principles on business and human rights. OECD CSR policy tool, ILO Tripartite Declaration of Principles on Multinational Enterprises and Social Policy.	**09**
3	**CSR-Legislation in India and the World** Section 135 of the Companies Act 2013.Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and the Implementation of the Computation of Net Profit in India.	**08**
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 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).	**08**
5	**Identifying key stakeholders of CSR** Role of Public Sector in Corporate, government programs, Nonprofit, and Local Self Governance in implementing CSR, Global Compact Self-Assessment Tool, National Voluntary Guidelines by the Govt. of India, and Roles and responsibilities of corporate foundations.	**08**
	Total	**42**

Books Recommended:

Textbooks:

- Corporate Social Responsibility in India, Sanjay K Agarwal, Sage Publications, 2008.
- Corporate Social Responsibility in India, Bidyut Chakrabarty, Routledge, New Delhi, 2015.

Reference Books:

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

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Human Resource Management (DJS22ILO8024)		

Objectives:

1. To introduce the students to basic concepts, techniques, and practices of human resource management.
2. To provide an opportunity of learning Human Resource Management (HRM) processes, related to the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students with the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders, and managers.

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

1. Understand the concepts, aspects, techniques, and practices of human resource management.
2. Understand the Human Resource Management (HRM) processes, functions, changes, and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with interpersonal and intergroup environments, emerging as future stable engineers and managers.

Human Resource Management (DJS22ILO8024)		
Unit	**Description**	**Duration**
1	**Introduction to HR** Human Resource Management- Concept, Scope, and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM, Human resource Planning, Technological change, Restructuring, and rightsizing. Empowerment, TQM, and Managing ethical issues.	**08**
2	**Organizational Behaviour (OB)** Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary Issues. Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness. Perception: Attitude and Value, Effect of perception on Individual Decision-making. Attitude and Behaviour. Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); Group Behaviour and Group Dynamics: Work groups, formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study.	**10**
3	**Organizational Structure & Design** Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power, Politics at the workplace, Tactics and	**08**

	strategies.	
4	**Human Resource Planning** Recruitment and Selection process, Job-enrichment, Empowerment-Job Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counselling. Career Planning. Training & Development: Identification of Training Needs, Training Methods. Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making: Strategic Intent-Corporate Mission, Vision, Objectives, and Goals.	**08**
5	**Labor Laws and Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act. **Emerging Trends in HR** Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment. Cross-Cultural Leadership and Decision Making: Cross-Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women, and ageing people, intra-company cultural differences among employees motivation.	**08**
	Total	**42**

Books Recommended:

Reference Books:

- Stephen Robbins, Organizational Behavior, 16th Ed, 2013.
- V SP Rao, Human Resource Management, 3rd Ed, 2010, Excel Publishing.
- Aswathapa, Human Resource Management: Text & Cases, 6th edition,
- C. B. Mamoria and SV Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
- P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
- Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Corporate Finance Management (DJS22ILO8025)		

Pre-requisites: Basic Knowledge of Algebra, Probability, and Statistics.

Objectives:

1. Overview of the 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, and dividend policy.

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

1. Understand the Indian finance system.
2. Apply concepts of time value, money, and risk returns to products, services, and businesses.
3. Understand corporate finance; evaluate and compare the performance of multiple firms.
4. Take Investment, finance, as well as dividend decisions.

Corporate Finance Management (DJS22ILO8025)		
Unit	**Description**	**Duration**
01	**Overview of the Indian Financial System:** Characteristics, Components, and Functions of the 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	**08**
02	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis. **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; Limitations of Ratio Analysis	**08**
03	**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.	**08**
04	**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. Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion-Accounting Rate of Return,	**09**

	Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR).	
05	**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	**09**
	Total	**42**

Books Recommended:

Reference Books:

- Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
- Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
- Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
- Financial Management, 11th Edition (2015) by 1. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.
- Financial Management, Theory & Practice 8th Edition (2011), by Prasanna Chandra: Tata McGraw Hill Education Private Limited, New Delhi.

Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Logistic and Supply Chain Management (DJS22ILO8026)		

Objectives:

1. To acquaint with the concept of key drivers of supply chain performance and their inter-relationships with strategy.
2. To acquaint with the design problems and develop an understanding of information technology in supply chain optimization.
3. To acquaint with the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

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

1. Demonstrate the functional strategy map of supply chain management.
2. Analyze the determinants of Supply Chain and Transportation networks design.
3. Demonstrate the need of coordination and sourcing decisions in supply chain.
4. Understand pricing, revenue management and role of IT in supply chain.
5. Understand various sustainability aspects of a supply chain.

Logistic and Supply Chain Management (DJS22ILO8026)		
Unit	**Description**	**Duration**
01	**Understanding the Supply Chain:** Objective, Importance, Decision Phases, Process Views. **Achieving Strategic Fit and Scope:** Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope, Challenges to Achieving and Maintaining Strategic Fit. **Supply Chain Drivers and Metrics:** Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing. **Creating the Responsive Supply Chain:** Product push versus demand pull, The Japanese philosophy, The foundations of agility, A route-map to responsiveness.	**8**
02	**Designing the Supply Chain and Transportation Networks** **Designing Distribution Networks:** The Role of Distribution in the Supply Chain, Factors Influencing Distribution Network Design, Design Options for a Distribution Network. **Network Design in the Supply Chain:** The Role of Network Design in the Supply Chain, Factors Influencing Network Design Decisions, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation. **Designing Global Supply Chain Networks:** The Impact of Globalization on Supply Chain Networks, The Offshoring Decision: Total Cost, Risk Management in Global Supply Chains, Discounted Cash Flows, Evaluating Network Design Decisions Using Decision Trees. **Transportation in a Supply Chain:** The Role of Transportation in a Supply Chain, Modes of Transportation and their Performance Characteristics, Design Options for a Transportation Network, Trade-Offs in Transportation Design, Tailored Transportation.	**10**

03	**Coordination in a Supply Chain:** Lack of Supply Chain Coordination and the Bullwhip Effect, The Effect on Performance of Lack of Coordination, Obstacles to Coordination in a Supply Chain, Managerial Levers to Achieve Coordination, Continuous Replenishment and Vendor-Managed Inventories, Collaborative Planning, Forecasting, and Replenishment. **Sourcing Decisions in a Supply Chain:** The Role of Sourcing in a Supply Chain, In-House or Outsource, Third- and Fourth-Party Logistics Providers, Using Total Cost to Score and Assess Suppliers, Supplier Selection-Auctions and Negotiations, Contracts, Risk Sharing and Supply Chain Performance, Design Collaboration, The Procurement Process.	**8**
04	**Pricing and Revenue Management in a Supply Chain:** The Role of Pricing and Revenue Management in a Supply Chain, Pricing and Revenue Management for Multiple Customer Segments, Pricing and Revenue Management for Perishable Assets, Pricing and Revenue Management for Seasonal Demand, Pricing and Revenue Management for Bulk and Spot Contracts. **Information Technology in a Supply Chain:** The Role of IT in a Supply Chain, The Supply Chain IT Framework, Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, Managing the supply chain as a network, Seven major business transformations, From 3PL to 4PL. The Future of IT in the Supply Chain.	**8**
05	**Creating a Sustainable Supply Chain:** The Role of Triple Bottom Line, Key Metrics for Sustainability, Greenhouse gases and the supply chain, Reducing the transport-intensity of supply chains, Beyond the carbon footprint, Reduce, reuse, recycle, Sustainability and Supply Chain Drivers. **Introduction to the Supply Chain of the Future:** Emerging Megatrends.	**8**
	Total	**42**

Books Recommended:

Reference Books:

- Logistics & Supply Chain Management, Martin Christopher, Pearson Education Limited, 2016.
- Supply Chain Management Strategy, Planning, and Operation, Sunil Chopra and Peter Meindl, Pearson, 2016.
- Essentials of Supply Chain Management, Michael H. Hugos, Wiley, 2018.
- Supply Chain Management For Dummies, Daniel Stanton, Wiley, 2020.
- Global Supply Chain and Operations Management A Decision-Oriented Introduction to the Creation of Value, Dmitry Ivanov, Alexander Tsipoulanidis and Jörn Schönberger, Springer International Publishing, 2016.
- Supply Chain Management, Sinha, McGraw-Hill Education (India) Pvt Limited, 2012.

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: IPR and Patenting (DJS22ILO8027)		

Objectives:

1. Understanding, defining, and differentiating different types of intellectual properties (IPs)
2. Assessing different IP management (IPM) approaches
3. Exposure to the Legal management of IP and understanding of real-life practice of IPM.

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

1. Recognize the crucial role of IP for the purposes of product and technology development.
2. Understand how and when to file a patent
3. Apply the knowledge to understand the entire ecosystem
4. Derive value from IP and leverage its value in new product and service development.

IPR and Patenting (DJS22ILO8027)		
Unit	**Description**	**Duration**
1	**Concept of Intellectual Property Law** Idea/Expression dichotomy, Introduction, and the need for intellectual property rights (IPR), Intellectual Property laws, IPR in India: Genesis and development, IPR abroad, Major International Instruments concerning Intellectual Property Rights: Paris Convention, the Berne Convention, the Universal Copyright Convention, the WIPO Convention, the Patent Cooperation Treaty, the TRIPS Agreement, incentive theory, types of IPR, India's New National IP Policy, 2016, Govt. Schemes in IPR IP	**8**
2	**Patents and Trademarks** Elements of Patentability: Novelty, Non-Obviousness, Industrial Application, Non Patentable Subject Matter, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties, Patent Office and Appellate Board, Case study of existing patents related to software, healthcare, and devices Concept of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols, well-known marks, certification marks, and service marks), Non Registrable Trademarks, Registration of Trademarks, Rights of holder and assignment and licensing of marks, Infringement, Remedies & Penalties, Trademarks registry and appellate board	**10**
3	**Copyrights and Designs** Copyrights: Nature, Subject matter: original literary, dramatic, musical, artistic works, cinematograph films and sound recordings, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright, Infringement, Remedies & Penalties, Related Rights, distinction between related rights and copyrights Design: meaning and concept of novel and original, procedure for registration, effect of registration and term of protection.	**8**
4	**GI, PVP, and LDP** Geographical indication: meaning, difference between GI and trademarks, procedure for registration, effect of registration, and term of protection. Plant variety protection: meaning, benefit sharing, farmers' rights, procedure for registration, effect of registration, and term of protection. Layout Design protection: meaning, procedure for registration, effect of registration, term of protection	**8**

5	**Beyond IP** Introduction to Competition Law: concept of competition, relationship and Interaction between IPR and competition law, IP and competition issues, Technology transfer agreements. EU experience with IP and Competition Law, the Indian Competition Act, and IPR protection, IPR issues in mergers and acquisitions, harmonization of IP protection, and competition Law in India.	**8**
	Total	**42**

Books Recommended:

Reference Books:

- Feroz Ali, The Law of Patents, LexisNexis
- Ronald D. Slusky, Invention Analysis and Claiming - A Patent Lawyer's Guide, Second Edition, American Bar Association, 2012.
- Feroz Ali, The Touchstone Effect: The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009.
- Innovation and entrepreneurship by Drucker. F. Peter, Harper's Business, (2006).
- Intellectual Property Rights, Deborah. E. Bouchoux, Cengage Learing.
- Intellectual Property Rights-Unleash The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,
- The Design of Business- by Martin Roger, Harvard Business Publishing (2009)

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Digital Marketing Management (DJS22ILO8028)		

Objectives:

1. To explain the evolution of digital marketing and outline the underlying technology and frameworks within which digital marketing operates.
2. To understand digital marketing business models elucidating on the six core digital value elements and how they can be used to generate customer value.
3. To understand the key concepts of developing strategy for digital business and the emerging business structures.
4. To plan the digital marketing strategy roadmap, its four key stages and their elements and understand the 6S Digital Marketing Implementation Stages.
5. To understand digital marketing planning & operations setup.
6. To explain the implementation of search campaigns which include Search Engine Marketing (SEM) and Search Engine Optimization (SEO) concepts.
7. To explain upcoming digital marketing concepts including Big Data and Internet of Things
8. (IoT), Small and Medium Businesses (SMB), B2B marketing and Social, Local and Mobile (SoLoMo) concept.

Outcomes: Upon Completion of the course, the learner should be able to:

1. Understand the digital marketing framework & model and consumer behaviour.
2. Develop a 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 (DJS22ILO8028)		
Unit	**Description**	**Duration**
1	**Introduction to Digital Marketing** Emergence of Digital Marketing as a tool, media consumption drivers for a 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, and critical success factors for digital marketing. **Digital Marketing Models Creation:** Factors impacting the digital marketplace, value chain digitization, and business models. **The Consumer for Digital Marketing:** Consumer behavior on the internet, evolution of consumer behavior models, managing consumer demand, integrated marketing communications (IMC), and impact of digital channels on IMC.	**8**
2	**Digital Marketing Strategy Development** Elements of the assessment phase, macro-micro environmental analysis, and marketing situation analysis. **Digital Marketing Internal Assessment and Objectives Planning:** Analyzing the present offerings mix, marketing mix, core competencies analysis, and internal resource mapping. Digital presence analysis, digital marketing objectives development, and review.	**10**

	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 a digital marketing strategy roadmap, the 6s digital marketing implementation strategy, and marketing across the product life cycle.	
3	**Digital Marketing Planning and Setup** Understanding digital media planning terminology and stages, steps to creating a marketing communications strategy, introduction to search marketing, display marketing, and 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.	**8**
4	**Digital Marketing Execution** Basic elements of digital campaign management, search execution, display execution, social media execution, and 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.	**8**
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.	**8**
	Total	**42**

Books Recommended:

Reference Books:

- Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson Education Limited.
- Digital Marketing by Seema Gupta- McGraw-Hill Education.
- Digital Marketing Excellence: Planning, Optimizing, and Integrating Online Marketing by
- Dave Chaffey and P. R. Smith, 5th edition, Taylor & Francis.
- Digital Marketing: Strategy, Implementation and Practice- 6th edition by Dave Chaffey, Fiona Ellis-Chadwick, Pearson Education Limited.
- Digital marketing by Vandana Ahuja, Oxford University Press.
- The Art of Digital Marketing by Ian Dodson, John Wiley & Sons.

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Environmental Management (DJS22ILO8029)		

Pre-requisites: Basic Knowledge of Probability and Statistics.

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise with environment-related legislation
4. Understand Environmental Auditing Procedures.

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

1. Identify Environmental issues and get familiarized with the concept of the Ecosystem and environmental management.
2. Know policies and legal aspects and understand EM system standards.
3. Understand the Environmental Impact Assessment.
4. Understand Environment Auditing procedures.
5. Describe Environmental Management Techniques

Environmental Management (DJS22ILO8029)		
Unit	**Description**	**Duration**
1	**Principles of Environmental Management (EM):** Introduction of EM, Definition, Ecosystem concept, Participants in EM, Ethics and the environment, International Environmental Movement, Environmental issues relevant to India.	**8**
2	**Policy and Legal Aspects of EM:** - Introduction to various Environmental Policies, Indian and International Environmental laws and legislation. **EM system Standards:** Core Elements, Benefits, Certification Body Assessment & Documentation for EMS, ISO-14000 Standards.	**9**
3	**Environmental Impact Assessment (EIA):** Purpose, steps, hierarchy of EIA, Environmental Impact Statement and Impact Indicators, Evolution of IA in India and worldwide. Preliminary stages of EIA, Impact, Prediction, Evaluation and Mitigation.	**9**
4	**Environmental Auditing (EA):-** Objectives, Scope and Types of EA, Audit Methodology, Elements of Audit Process, Auditing of EMS.	**8**
5	**Environmental Management Techniques: -** Environmental Monitoring and Modelling, Environmental technology Assessment and Environmental Risk Assessment, Eco-mapping.	**8**
	Total	**42**

Books Recommended:

Text Books:

- Environmental Management, T V Ramachandra and Vijay Kulkarni, TERI Press
- Environmental Management: Principles and Practice, CJ Barrow, Routledge Publishers, London, 1999

Reference Books:

- A Handbook of Environmental Management, Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing.
- Indian Standard Environmental Management Systems - Requirements with Guidance for Use, Bureau Of Indian Standards, February 2005.
- Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000.
- Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press.
- Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015.

Program: Common for All Programs	**Final Year B.Tech**	**Semester: VIII**
Course: Labour and Corporate Law (DJS22ILO8030)		

Objectives:

1. To understand the development and judicial setup of Labour Laws.
2. To learn the laws relating to Industrial Disputes, Social Security, and Working Conditions.
3. To analyse the laws related to corporate governance in different settings.
4. To develop awareness of legal principles involved in economic relationships and business transactions.
5. To develop an understanding of the free enterprise system and the legal safeguards of the same.

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

1. Illustrate the role of a trade union in the industrial setup.
2. Understand the important causes, impact of industrial disputes, and settlement procedures.
3. To provide an in-depth understanding of corporate social responsibility.
4. Apply concepts, principles, and theories to understand simple business laws.
5. Analyse the principles of international business and the strategies adopted by firms to expand globally.

Labour and Corporate Law (DJS22ILO8030)		
Unit	**Description**	**Duration**
1	**Trade Unions and Collective Bargaining:** Trade Unionism in India, Definition of Trade Union and Trade Dispute, General and Political Funds of Trade Union, Civil and Criminal Immunities of Registered Trade Unions, Recognition of Trade Union, Collective Bargaining	**8**
2	**Industrial Dispute and Instruments of Economic Coercion:** Industrial Dispute and Individual Dispute, Settlement of Industrial Dispute. Concept of strike, Gherao, Bandh, and Lock-out, Types of Strike, Rights to Strike and Lock-out	**9**
3	**Formation of a Company and Corporate Governance:** Company and Other Forms of Business Organizations, Different Kinds of Companies: One Person Company, Foreign Company. Kinds of Company Meetings and Procedure Powers, Duties, and Kinds of Directors: Independent Director, Women Director. Different Prevention of Oppression and Mismanagement, Investor Protection, Insider Trading, Corporate Fraud.	**9**
4	**Corporate Social Responsibility and Corporate Liquidation:** Evolution of Corporate Social Responsibility, Corporate Criminal Liability, Corporate Environmental Liability, Different Types of Winding up of Company, Role of Courts in Winding up of Company, Merger and Acquisition of Company, Cross-Border Merger, Takeover Code: Role of SEBI	**8**
5	Case Studies on A) Labour law B) Labour relations C) Corporate laws D) Securities laws	**8**
	Total	**42**

Books Recommended:

Reference Books:

- Surya Narayan Misra, An Introduction to Labour and Industrial Law, Allahabad Law Agency, 1978.
- Indian Law Institute, Cases and Materials on Labour Law and Labour Relations, P.L. Malik, Industrial Law, Eastern Book Company, 2013.
- S.C. Srivastava, Industrial Relations and Labour Law, Vikas Publishing House, New Delhi.
- C.A. Kamal Garg, Bharat's Corporate and Allied Laws, 2013.
- Institute of Company Secretaries of India, Companies Act 2013, CCH Wolter Kluver Business, 2013.
- Saleem Sheikh & William Rees, Corporate Governance & Corporate Control, Cavendish Publishing Ltd., 1995
- Taxmann, A Comparative Study of Companies Act 2013 and Companies Act 1956.

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

Course: Project Stage - II (DJS22DSP803)

Objectives:
To introduce the students to professional engineering practice by providing them with an opportunity to work on an open-ended engineering problem. Typically, the students would apply knowledge from different areas or courses, which they have studied in their curriculum using methods, tools, and techniques, which they learned to a real-world scenario. Students would have to apply not only their engineering knowledge and proficiencies (hard skills), but also to demonstrate their competence in generic, professional skills (soft skills). It also emphasizes the importance of life-long learning as a fundamental attribute of graduate engineers.

Outcomes: On completion of the course, learner will be able to:
1. Develop the proposed solution using appropriate techniques.
2. Test the developed system for its correctness using appropriate techniques.
3. Work effectively as a member of the team.

Guidelines
1. The department must allocate 2 days in the Semester VIII every week.
2. Students will do coding and testing in Semester VIII.
3. Each group along with its guide/mentor shall identify appropriate techniques for testing the developed system.
4. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Program.
5. A report is to be prepared summarizing the findings of the literature survey, coding and testing.
6. Every team must publish their work in national / international conference/journals (if possible, publish in Scopus indexed journals) or file a patent.

Prepared by Checked by Head of the Department Principal

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

Course: Disaster Management and Preparedness (DJS22A4)

Objectives:

1. To provide basic understanding of hazards, disasters and various types and categories of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand roles and responsibilities of individual and various organizations during and after disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

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

1. Apply disaster management principles & guidelines.
2. Conduct risk assessments.
3. Develop community awareness & participation.
4. Utilize Science & Technology tools (GIS, GPS).
5. Prepare disaster management plans.

Disaster Management and Preparedness (DJS22A4)		
Unit	**Description**	**Duration**
1	**Understanding Disasters & Hazards** **Definition and types of disasters**: Natural, Man-made and hybrid disasters, **Study of Natural disasters**: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc. **Study of Human/Technology Induced Disasters**: Chemical, Industrial and Nuclear disasters, internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Hazard & Vulnerability profiles of India (seismic zones, flood-prone areas). India's vulnerability to disasters, and the impact of disasters on National development.	**06**
2	**Disaster Risk Reduction (DRR) & Mitigation** **Disaster Management Cycle**: Prevention, Mitigation, Preparedness, Response, Recovery. Need for disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction. Risk Assessment & Vulnerability Analysis. **Science & Technology**: Use of information management, Geo informatics like RS, GIS, GPS and remote sensing mitigation measure.	**06**
3	**Disaster Preparedness & Response** Preparedness Planning, Early Warning Systems (EWS), & Communication. Emergency Response: Search & Rescue, Logistics, Medical Aid. Psychological Response & Management (Trauma, Stress). Role of IT, Media, Govt., NGOs, & Community.	**04**

4	**Recovery, Rehabilitation & Reconstruction** Post-disaster damage assessment. Rehabilitation, Reconstruction, & Livelihood Restoration. Sanitation, Hygiene, & Waste Management.	**04**
5	**Policy, Governance & Capacity Building** National Disaster Management Authority (NDMA) & Legislation. Institutional Mechanisms & Community Mobilization. Non-Structural Mitigation: Community based disaster preparedness, capacity development and training, awareness and education, contingency plans.	**04**
6	**Case studies on disaster (National /International)** Case study discussion of National Disasters: Tsunami (2004), Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, 26th July 2005 Mumbai flood Case study discussion of International Disasters: Hiroshima – Nagasaki (Japan), Cyclone Phailin (2013), Fukushima, Daiichi nuclear disaster (2011), Chernobyl meltdown	**04**
	Total	**28**

Books Recommended:

Reference Books and Reports:

1. Disaster Management, by Harsh K. Gupta, Universities Press Publications (2003).
2. Disaster Management: An Appraisal of Institutional Mechanisms in India, by O. S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. Introduction to International Disaster Management, by Damon Copolla, Butterworth Heinemann Elsevier Publications (2015).
4. Disaster Management Handbook, by Jack Pinkowski, CRC Press, Taylor and Francis group (2008).
5. Disaster management & rehabilitation, by Rajdeep Dasgupta, Mittal Publications, New Delhi (2007).
6. Natural Hazards and Disaster Management, Vulnerability and Mitigation, by R B Singh, Rawat Publications (2006).
7. Concepts and Techniques of GIS, by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications (2006).
8. Risk management of natural disasters, by Claudia G. Flores Gonzales, KIT Scientific Publishing (2010).
9. Disaster Management – a disaster manger's handbook, by W. Nick Carter, Asian Development Bank (2008).
10. Disaster Management in India, by R. K. Srivastava, Ministry of Home Affairs, GoI, New Delhi (2011)
11. The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy, by Wil Mara, Marshall Cavendish Corporation, New York, 2011.
12. The Fukushima 2011 Disaster, by Ronald Eisler, Taylor & Francis, Florida, 2013.

(Learners are expected to refer reports published at national and international level and updated information available on authentic web sites.)