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 VII)

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 - VII for Department of Computer Science and Engineering (Data Science)
Academic Year - 2025 - 2026

Sr	CourseCode	Course	Teaching Scheme(hrs.)				SemesterEndExamination(A)						ContinuousAssessment(B)					Aggregate(A+B)	Credits	
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration	Theory	Oral	Pract	Oral& Pract	EndSem ExamTotal	TermTest 1(TT1)	TermTest 2(TT2)	Total(TT &TT2)	TermWorkTotal	CA Total			
1	DJS22DSC701	Language Models	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	4
	DJS22DSL701	Language Models Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJS22DSC702	Information Security	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	4
2	DJS22DSL702	Information Security Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	25	25	50	1	
3	DJS22DSL703	Applied Data Science Laboratory	1	2	--	2	--	--	--	--	--	--	--	--	--	50	50	50	2	2
	DJS22DSC7011	Parallel Computing	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	4
	DJS22DSL7011	Parallel Computing Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJS22DSC7012	Geo-Spatial Data Science	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22DSL7012	Geo-Spatial Data Science Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJS22DSC7013	Advanced Internet of Things	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
4 @	DJS22DSL7013	Advanced Internet of Things Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJS22DSC7014	Adversarial Machine Learning	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22DSL7014	Adversarial Machine Learning Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
	DJS22ILO7011	Product LifeCycle Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	3
	DJS22ILO7012	Management Information System	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7013	Operations Research	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7014	Cyber Security and Laws	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7015	Personal Finance Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7016	Energy Audit and Management	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7017	Disaster Management and Mitigation Measures	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
5#	DJS22ILO7018	Science of Well-being	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7019	Research Methodology	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
	DJS22ILO7020	Public Systems and Policies	3	--	--	3	2	65	--	--	--	65	20	15	35	--	35	100	3	
6	DJS22DSP704	Project Stage - I	--	4	--	2	2	--	--	--	50	50	--	--	--	50	50	100	2	2
		Total	**13**	**12**	**0**	**19**	**12**	**260**	**25**	**0**	**50**	**335**	**80**	**60**	**140**	**175**	**315**	**650**	**19**	**19**

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

Prepared by Checked by Head of the Department Principal

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

Course: Language Models (DJS22DSC701)

Language Models Laboratory (DJS22DSL701)

Pre-requisite: Machine Learning-I, Machine Learning-II, Foundations of Data Analysis, Statistics for Data Science, Natural Language Text Processing.

Course Objectives: To introduce the fundamentals of neural language models, pre-training, fine-tuning, and evaluation techniques. The course aims to provide hands-on experience in developing and deploying large language models (LLMs) while addressing ethical concerns and safety measures.

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

1. Understand the architecture and working principles of modern language models such as Transformers, BERT, and GPT.
2. Apply pre-training and fine-tuning techniques to optimize language models for real-world applications.
3. Analyze various evaluation metrics to assess the performance and reliability of language models.
4. Develop applications using large language models for tasks such as text generation, question answering, and multimodal AI.

Language Models (DJS22DSC701)		
Unit	**Description**	**Duration**
1	**Natural Language Generation:** Limitations of RNNs & LSTMs in Language Modeling, Encoder-Decoder Models, Attention Mechanism: Motivation & Evolution, Seq2Seq with Attention. **Transformers:** Self-Attention Mechanism: Query-Key-Value Representation ,Scaled Dot-Product Attention , Multi-Head Attention, Positional Encoding, Transformer-based Encoder-Decoder Architectures.	**06**
2	**Large Language Models Architectures:** **Encoder Models:** BERT architecture and working, BERT variants: RoBERTa, ALBERT, DistilBERT, Applications: Text Classification, Named Entity Recognition (NER) **Decoder Models (Autoregressive LLMs)**: GPT Family (GPT-3, GPT-4, GPT-4 Turbo) **Open-source model**: LLaMA	**08**
3	**Pre-training & Fine-tuning of LLMs:** **Pre-training Strategies:** Self-Supervised Learning in LLMs, Next Token Prediction (Auto-regressive) vs. Masked Language Models (Auto-encoding), Pre-training Methods: Causal LM,	**08**

	Prefix LM, Sequence-to-Sequence Pre-training. **Fine-tuning Techniques:** Supervised Fine-tuning & Transfer Learning, Parameter-efficient Fine-tuning (LoRA, Adapter Layers), gradient accumulation, fine-tuning, gradient check pointing, quantization, Few-shot, Zero-shot, and Multi-Task Learning **Prompt Engineering & Adaptation**: Instruction Tuning, Chain-of-Thought (CoT) Prompting ,Self-consistency & ReAct (Reasoning + Acting) ,Prompt-aware Training Methods.	
4	**Evaluation Metrics:** Traditional Evaluation Metrics BLEU, ROUGE, METEOR, BERTScore, GLUE, SQuAD, MMLU (Massive Multitask Language Understanding), LLM-Specific Evaluation Methods, Embedding-based Metrics, GPT-Score, AI Arena, HELM (Holistic Evaluation of Language Models), TruthfulQA for Factual Accuracy.	**05**
5	**Real-World Applications & Future Trends:** Question Answering Systems:IR-based vs. Knowledge-based QA, Retrieval-Augmented Generation (RAG) using Langchain, LLMs for Legal & Medical NLP **AI Agents & Autonomous LLMs**: OpenAI's AutoGPT, BabyAGI, Agentic Workflows & Planning LLMs.	**05**
6	**Reinforcement Learning with Human Feedback (RLHF) & Safety:** **RLHF Process in Modern LLMs**: Reward Modelling for LLM Alignment, Reinforcement Learning Techniques: Proximal Policy Optimization (PPO), Comparative Ranking & Preference Learning, Group Relative Policy Optimization (GRPO). **RLAF:** Reinforcement Learning through Agent Feedback (RLAF), How RLAF works, Difference between RLAF and RLHF. **LLM Alignment & Bias Mitigation:** Ethical Risks: Bias, Misinformation, Hallucinations, Adversarial Attacks on LLMs, Safety in Large Models: Constitutional AI, Red-teaming.	**08**
	Total	**39**

Language Models Laboratory (DJS22DSL701)	
Exp.	**Suggested Experiments**
1	Implementing Sequence-to-Sequence (Seq2Seq) Models for performing language translation.
2	Implementing Transformer Models for Natural language Processing Tasks.
3	Fine-Tuning BERT for performing Natural language Processing Tasks.
4	Implement LoRA and Adapter Layers for Fine-Tuning Pre-trained language Models.
5	Implement techniques to elicit desired behaviours from LLMs using prompts.
6	Implementing and Comparing Evaluation Metrics for LLMs.
7	Developing Question Answering System using Information Extraction.
8	Developing Retrieval-Augmented Generation (RAG) Systems using Langchain
9	Using GRPO to Train a Model for Reasoning
10	Building Autonomous AI Agents with LLMs
11	Efficient Inference and Deployment of Large Language Models

12	Mini Project

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

Books Recommended:

Text Books:

1. Jurafsky and Martin, "Speech and Language Processing", Prentice Hall, 3rd Edition, 2020.
2. Uday Kamath, "Deep Learning for NLP and Speech Recognition", 1st Edition, 2019.

Reference Books:

1. Jelinek, F., "Statistical Methods for Speech Recognition", The MIT Press, 2022.
2. Yuli Vasiliev "Natural Language Processing with Python and spaCy - A Practical Introduction", No Starch Press, 2022.
3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems", O'Reilly, 1st Edition, 2020.

Web Links:

1. NPTEL link: Introduction to Large Language Models (LLMs) - - Announcements
2. NPTEL Course: https://cse.iitm.ac.in/~miteshk/llm-course.html
3. NPTEL Course: https://onlinecourses.swayam2.ac.in/imb24_mg116/preview

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

Course: Information Security (DJS22DSC702)

Information Security Laboratory ((DJS22DSL702)

Pre-requisite: Computer Communication and Networks.

Course Objectives:

1. Gain a comprehensive understanding of cyber threats, defence strategies, cryptographic principles, and modern security practices to safeguard digital assets.
2. Learn symmetric and asymmetric cryptography, key management, hashing techniques, and authentication protocols to ensure data confidentiality, integrity, and authentication.
3. Examine various network attacks, security mechanisms like firewalls, IDS, IPS, and encryption protocols to design and implement robust network defence strategies.

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

1. Analyse different types of cyber threats, cryptographic techniques, and their role in securing data and communication systems.
2. Apply cryptographic algorithms like AES, RSA, and Diffie-Hellman for secure key management and data encryption.
3. Evaluate the effectiveness of authentication methods, including Kerberos, biometrics, and digital certificates, in ensuring system integrity.
4. Develop and Implement security solutions using firewalls, IDS, IPSec, and SSL protocols to mitigate network-based cyber threats.

Information Security (DJS22DSC702)		
Unit	**Description**	**Duration**
1	**Introduction:** Cyber Attacks, Defense, Strategies and Techniques, Guiding Principles of Modern Security Practices. OSI security model.	**04**
2	**Number Theory:** Modulo Arithmetic, Euclid's Algorithm, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Cipher Properties, Substitution Ciphers – Mono-alphabetic Ciphers, Polyalphabetic Ciphers, Transposition Ciphers.	**06**
3	**Symmetric Cryptography:** Block Cipher, Fiestel Structure, Block Cipher Modes of Operation, S-DES, Double DES, Triple DES, AES Algorithm.	**08**
4	**Asymmetric Cryptography:** Private Key and Public Key Cryptography, The RSA algorithm, Key Management, Diffie-Hellman Key Exchange, Key Exchange Algorithm.	**07**
5	**Integrity and Authentication:** Hashing: Properties of cryptographic hash, message digest, MD-5, SHA-1. Public Key Infrastructure (PKI), One way and mutual authentication, Needham-Schroeder Protocol, Authentication methods, Kerberos Authentication Protocol, Biometrics, Digital Certificates: X.509.	**07**

6	**Network Security:** Network attacks, DoS and DDoS attack, Sniffing, Session hijacking, Spoofing, Phishing, Cross-site Scripting (XSS), IPSec Protocol, SSL Handshake Protocol, Firewalls, IDS Prevention and Detection.	**07**
	Total	**39**

Information Security Laboratory ((DJS22DSL702)	
Exp.	**Suggested Experiments**
1	Implement Playfair Cipher with key entered by user.
2	Implement polyalphabetic Cipher
3	Implement Simple and Advanced Columner Transposition technique
4	Implement Simplified DES
5	Implement Simple RSA Algorithm with small numbers.
6	Implement Diffie-Hellman Key Exchange
7	Implement DoS and DDoS attack using Hping.
8	Implement phishing attack using HTTrack Website Cloning.
9	Implement static code analysis using Flawfinder Python Distribution.
10	Implement packet sniffing using Wireshark and TCP Dump.
11	Implement cross site request forgery in a controlled virtual environment using DVWA Web Server.
12	Implement firewalls using IP tables.
13	Implement Network Intrusion Detection System (NIDS).
14	Implement Host based Intrusion Detection System (HIDS).

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

Books Recommended:

Text Books:

1. William Stallings, "Cryptography and Network Security Principles and Practices", Pearson/PHI, 8th Edition, 2023.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill, 3rd Edition, 2017.

Reference Books:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India, 5th Edition, 2015.
2. Atul Kahate, "Cryptography and Network Security", McGraw Hill, 3rd Edition, 2013.
3. Bernard Menezes, Network Security and Cryptography, Cengage Learning, 2nd Edition, 2011.
4. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson, 2nd Edition, 2006.
5. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, 1st Edition, 2003.

Web Links:

1. Damn Vulnerable Web Application (DVWA): http://dvwa.co.uk
2. Open Web Application Security Project: https://owasp.org
3. Web penetration testing: https://pentesterlab.com 4. Penetration Testing: https://kali.org

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

Course: Applied Data Science Laboratory (DJS22DSL703)

Pre-requisite: Machine Learning, Data Engineering.

Course Objectives:
To bridge the gaps between industry and academia. Give the exposure of production system and applied data science.

Course Outcomes: On completion of the course, learner will be able to:
1. Relate to production systems available in the industry.
2. Debug various problems occurred in a data science production system.

Applied Data Science Laboratory (DJS22DSL703)		
Unit	**Description**	**Duration**
1	**Converting Business problem into Data Science Problem:** • Bridging the Qualitative-to-Quantitative Gap in Data Science • Right Data Available with the Right Level of Granularity • Repeatability and Reproducibility: Consistency in Labelled Data for Accurate AI Systems	**04**
2	**Agile Methodology:** • Work Breakdown structure for Agile Models • Scrum/XP modelling of Data Science Projects • Agile Tools for Project Management	**06**
3	**Data Preparation Best Practice:** • Gathering suitable data for Data Science problem • Determine all Key Performance Indicators (KPIs) • Business stakeholders POC Dashboard	**04**
4	**Data Modelling:** • Selection of appropriate tool • Data Modelling with Incremental Data • Robust model design. • Data Modelling with different data formats	**06**
5	**Model Building Best Practice:** • One hot encoding • Selecting right metrics to evaluate the model • SHAP and LIME for interpretability of model.	**06**
6	**Model Compression** • Quantization • Pruning • Knowledge Distillation	**04**

7	**Modelling and Optimization Trade-off:** • Need of Optimization • Different methods of Optimization • Development • Rest APIs	**02**
8	**Data Science Project Architecture:** • Functions of MLOps/DevOps • Difference between MLOps and DevOps • Collaboration, Scalability and Reusability	**02**
9	**Project Deployment:** • Flask • Docker • Kubernetes	**04**
10	**A/B Testing:** • Formulate Hypothesis • Create Test Group • Compare Results	**02**
	Total	**26**

*The Term Work will be calculated based on Laboratory Performance (20m), Attendance (10m) and Quizzes (20m).

Books Recommended:

Textbooks:

1. Probyto Data Science and Consulting Pvt. Ltd, Data Science for Business Professionals, bpb publications, 2020.
2. Emmanuel Ameisen, Building Machine Learning Powered Applications, O'Reilly, 2020.

Reference Books:

1. Valliappa Lakshmanan, Sara Robinson and Michael Munn, Machine Learning Design Patterns, O'Reilly, 2021.
2. Emily Robinson and Jacqueline Nolis, Build a career in Data Science, Manning, 2020.
3. Andriy Burkov, Machine Learning Engineering, True Positive Inc, 2020.

Web Links:

1. Coursera course: IBM Data Science Professional Certificate | Coursera
2. https://www.coursera.org/specializations/data-science-python?msockid=0a3d4df1db7a6b8909345878dac86aa5
3. https://onlinecourses.nptel.ac.in/noc21_cs23/preview

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DEPARTMENT ELECTIVE COURSE

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

Course: Parallel Computing (DJS22DSC7011)

Parallel Computing Laboratory (DJS22DSL7011)

Pre-requisite: System Fundamentals

Course Objectives:
To familiarize students with the fundamental concepts, techniques and tools of parallel computing.

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

1. Understand different structures of Parallel Computers.
2. Apply parallel algorithms in problem solving.
3. Evaluate the performance of parallel computing models and algorithms.

Parallel Computing (DJS22DSC7011)		
Unit	**Description**	**Duration**
1	**Introduction:** Introduction to Parallel computing, Abstract model of serial & parallel computation, pipelining, data parallelism, control parallelism, scalability, topologies in processor organization, parallel computing design consideration, parallel algorithms & parallel architectures, speedup and efficiency, supercomputers.	**08**
2	**System Architecture:** Shared memory multiprocessors (UMA-Uniform memory Access), Distributed memory multiprocessors (NUMA- Non-Uniform memory Access), SIMD, Systolic processor, Cluster computing, Grid computing, Multicore Systems.	**06**
3	**Parallel Algorithms:** Introduction to parallel algorithms, parallel algorithm models, Decomposition Techniques, characteristics of tasks & interactions, mapping techniques for load balancing, methods for containing interaction overheads.	**06**
4	**Parallel Algorithm Applications:** Matrix multiplication, parallel reduction, parallel sorting (Bubble sort, Quick sort), Graph algorithm (Minimum Spanning Tree - Prim's Algorithm), Fast Fourier Transform (serial and transpose algorithm).	**08**
5	**Parallel Programming:** Parallel programming models, point to point communication, synchronous and asynchronous communication, shared memory programming, message passing programming, MPI, PVM, Threads.	**08**
6	**Applications of Parallel Programming:** Issues and challenges, scope of parallel computing, applications in data mining, computer security and cryptography, medicine and human organ modelling.	**05**
	Total	**39**

Parallel Computing Laboratory (DJS22DSL7011)	
Exp.	**Suggested Experiments**
1	To implement the parallel construct in OpenMP that creates a parallel region in a C++ code.
2	To write an OpenMP program for illustrating the Fork Join model.
3	To implement SPMD (Single Instruction Multiple Data) parallel program in OpenMP.
4	To write a simple OpenMP program to demonstrate the sharing of loop iteration by a number of threads. (Take chunk size of 10).
5	To write an OpenMP program for finding prime numbers.
6	To write an OpenMP program to demonstrate sharing of section work by performing arithmetic operations on a one-dimensional array.
7	To write an OpenMP program to perform dot product of two one-dimensional arrays.
8	To implement the program for Matrix addition and Matrix multiplication using OpenMP.
9	To implement the program for sorting algorithms (Bubble sort, Quick sort) in OpenMP.
10	To implement the program to create a Minimum Spanning Tree using Prim's algorithm.

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

Books Recommended:

Text books:

1. Thomas Rauber, Gudula Rünger, Parallel Programming for Multicore and Cluster Systems, Springer, 2nd Edition, 2020.
2. Steven Brawer, Introduction to Parallel Programming, Academic Press Inc, 1st Edition, 2000.
3. M.Sasikumar, Dinesh Shikhare, P. Ravi Prakash, Introduction to Parallel Processing, Prentice Hall, 2nd Edition, 2014.

Reference Books:

1. David Bader, Handbook of Parallel Computing: Models, Algorithms and Applications, CRC Press, 1st Edition, 2023.
2. Fayez Gebali, Algorithms and Parallel Computing, Wiley Series, 1st Edition, 2011.
3. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, An Introduction to Parallel Computing: Design and Analysis of Algorithms, Pearson Publication, 2nd Edition, 2004.

Web Links

1. NPTEL course: https://archive.nptel.ac.in/courses/106/102/106102163/
2. Parallel Programming: Introduction to Parallel Computing Tutorial | HPC @ LLNL

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

Course: Geo-Spatial Data Science (DJS22DSC7012)

Geo-Spatial Data Science Laboratory ((DJS22DSL7012)

Pre-requisite: Data Visualization, Machine Learning and Artificial Intelligence.

Course Objectives:

1. To understand geospatial data sources, students will explore satellite imagery, GPS, and open datasets.
2. To effectively work with spatial data, they will learn pre-processing, cleaning, and geocoding techniques for seamless integration.

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

1. Apply tools and techniques used to analyze and visualize geospatial data.
2. Applying data science methods to solve real-world problems with geospatial data.
3. Analyze geospatial large data models and ethical issues.

Geo-Spatial Data Science (DJS22DSC7012)		
Unit	**Description**	**Duration**
1	**Introduction to Geospatial Data**: Introduction to Geographic Information Systems (GIS), Data Collection and Sources, Remote sensing and satellite imagery, GPS data and tracking, Coordinate systems and projections, Overview of geospatial data: Coordinates, attributes, temporal information; static and dynamic data, Spatial Data Types: vector and raster data, network data and Spatial Data Formats: shape files, geodatabases, Spatial data structures: Geometric objects (Points, lines and polygon), qualitative binary relation between geometrics and GSD applications.	**06**
2	**Geospatial Data Modeling:** Feature based approach: point, curve, surface, geometry collection; Algebra and calculi of qualitative spatial relations, topological relations, RCC-8, cardinal directions, Field based approach. Spatial regression, clustering, and optimization, Geo statistics and spatial modeling, Predictive modeling with geospatial data, Case study: Predicting property values, Spatial Analysis, Buffer analysis, spatial joins, spatial econometrics and geographically weighted regression (GWR).	**08**
3	**Linked Geospatial Data:** Visualizing Linked Geospatial Data, Querying Geospatial Data Expressed in RDF, Transforming Geospatial Data into RDF, SPARQL, Interlinking Geospatial Data Sources, Incomplete Geospatial Information, Geospatial RDF stores, Geospatial Knowledge Graphs, Question Answering Engines for Geospatial Knowledge Graphs, choropleth mapping.	**09**

4	**Geospatial Visualization:** Introduction to data visualization libraries (e.g., Matplotlib, Folium, Plotly), Creating basic maps and charts, customizing geospatial visualizations, creating maps and charts, Customizing geospatial visualizations Python toolkits Geospatial Visualization. Spatial Data, GIS, Geospatial Data, Geospatial Analysis, Data Visualization	**06**
5	**Data Ingestion & Big Data**: web scraping and APIs, distributed computing frameworks (e.g., Google Earth Engine, Hadoop GIS, GeoSpark, and Dask for geospatial data), and Google BigQuery GIS for scalable processing; Streaming Geospatial Data: IoT devices, GPS tracking, weather stations, and OpenStreetMap live updates. Spatial Analysis: Spatial queries and operations; Spatial Data Indexing: Quadtrees, R-trees, and Hilbert Curves to optimize geospatial queries. Spatial Relationships & Topology: topological consistency (e.g., via OGC Simple Features Specification). Spatial Statistics: spatial autocorrelation (Moran's I, Geary's C), and spatial interpolation techniques (Kriging, IDW).	**05**
6	**GIS Softwares** Introduction to web mapping tools (e.g., Leaflet), Exploring GIS software (e.g., QGIS, ArcGIS), Introduction to geospatial libraries (e.g., Geopandas, Fiona, Shapely), Building interactive web maps, Geospatial big data and distributed computing, Machine learning for geospatial data, Geo Spatial Data Ethics, Ethical considerations in geospatial data analysis.	**05**
	Total	**39**

Geo-Spatial Data Science Laboratory ((DJS22DSL7012)	
Exp.	**Suggested Experiments**
1	Apply cyberGIS techniques to analyze and visualize big geospatial data in Python using advanced cyberinfrastructure and high-performance computing.
2	Apply Python tools for developing high-performance geospatial computing solutions. Optimize and speed up geospatial computation using Python libraries like Numba, Cython and Dask, Ray, or PySpark for large-scale geospatial processing
3	Implement open source mapping and large-scale geospatial visualization libraries such as Leaflet, D3,Plotly Kepler.gl, Deck.gl and Cesium.js for 3D geospatial applications and mash up these libraries to create interactive and dynamic visualization tools and GIS applications.
4	Apply tools to investigate and identify patterns, clusters, classes, and anomalies based on various types of geospatial data and apply these techniques to a variety of geospatial applications.
5	Apply advanced techniques of spatial analysis, including spatial autocorrelation, trend surface analysis, grouping and regionalization procedures, and point pattern analysis to solve geospatial problems. spatial clustering methods (e.g., DBSCAN, K-Means with spatial constraints, HDBSCAN) and spatial econometrics modeling (spatial lag and spatial error models)

6	Solve given geospatial problem using ESRI ArcGIS solutions stack.
7	Identify right tool to interlink dataset to transform unlinked geospatial data into linked data using geospatial semantic technologies (geospatial ontologies, stRDF, stSPARQL, GeoSPARQL, OBDA mappings techniques. thing (e.g., a dataset containing information about roads in Crete can be interlinked with a dataset containing land cover information about Crete).
8	Analyze and visualize the data with the help of appropriate linked data tools using a sequence of GeoSPARQL queries!
9	Geospatial science in forestry and watershed management Geospatial science in urban planning and resource management
10	Use geospatial libraries for Geospatial Data Analysis with Python (e.g., Geopandas, Fiona, Shapely for Analyzing and visualizing geospatial data in Python
11	Demonstrate the use of Apache, Jena and Stardog for managing large-scale geospatial knowledge graphs.

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

Books Recommended:

Text Books

1. Geospatial Data Science: A Hands-on Approach for Building Geospatial Applications Using Linked Data Technologies June 2023.
2. Applied Geospatial Data Science with Python, David S. Jordan, Feb 2023.
3. Geospatial data analysis on AWS, ACM Publisher, Janahan Gnanachandran, 2023.
4. Geospatial Data Science Techniques and Applications", Paul A. Zandbergen, 2020.
5. "Introduction to Geographic Information Systems", Kang-Tsung Chang, McGraw-Hill Education, 2019.

Reference Books

1. "Geoprocessing with Python", Chris Garrard, Manning Publisher, 2016.
2. "Geospatial Analysis: A Comprehensive Guide", Michael J. de Smith, Michael F. Goodchild, and Paul A. Longley, Winchelsea Press, 2018.
3. The Ultimate Guide to Geospatial Data Science, Geospatial Data Science Explained: A Full Guide - Aya Data

Web Links

1. The Ultimate Guide to Geospatial Data Science, Geospatial Data Science Explained: A Full Guide - Aya Data https://www.ayadata.ai/the-ultimate-guide-to-geospatial-data-science/
2. ***https://www.safegraph.com/guides/geospatial-data***

Prepared by Checked by Head of the Department Principal

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

Course: Advanced Internet of Things (DJS22DSC7013)

Advanced Internet of Things Laboratory ((DJS22DSL7013)

Pre-requisite: Basic Programming Knowledge, Networking Fundamentals, Microcontrollers & Embedded Systems Basics.

Course Objectives:

1. To Introduce Advanced IoT Concepts and Architectures-
2. To Provide In-Depth Knowledge of IoT Communication Protocols
3. To Develop Skills in IoT Hardware and Software Integration
4. To Address IoT Security, Privacy, and Ethical Issues
5. To Design and Develop Industrial IoT (IIoT) and Smart Applications

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

1. Understand Advanced IoT Architectures & Communication Protocols
2. Design and Develop IoT Systems and apply
3. Integrate Cloud, Edge, and Fog Computing in IoT Solutions
4. Apply Big Data Analytics and AI/ML Techniques in IoT

Advanced Internet of Things (DJS22DSC7013)		
Unit	**Description**	**Duration**
1	**Introduction to Advanced IoT** Evolution from traditional IoT to Advanced IoT, IoT ecosystem overview **IoT Architecture and Design** Drivers behind new network architecture , comparing IoT architectures: The oneM2M IoT Standardized Architecture, The core IOT functional stack, **IoT Data Management and Compute Stack**: Fog and Edge Computing in IoT. **Smart objects**: The Things in IoT Sensors, Actuators, Microelectro Mechanical system **Connecting Smart Objects**: Communication criteria, IoT access technologies: IEEE 802.15.4, physical Layer ,MAC Layer, Topolgy, Security	**09**
2	**Sensors, Endpoints and Power system** Sensors, Actuators, PIR sensors and Smart Objects, Thermocouples and temperature sensing, LiDAR an active sensing system, MEMS sensors, Smart IoT endpoints, Sensor fusion, functional examples, Energy sources and power management, **Communication and Information Theory: Communication** theory, Information Theory, radio structure	**05**

3	**Cloud and Fog Topologies**: Cloud service Model ,Public ,private and hybrid cloud Openstack cloud architecture constraints of cloud architecture for IoT Fog computing. **IoT edge to cloud protocols**: MQTT,MQTT-SN, Constrained Application protocol, other protocols	**05**
4	**Power Line communication Technology: Overview** of PLC technologies ans standards, Architecture for home network technologies, IoT using PLC Technology. **IoT Security:** Common challenges in OT Security**,**Cyber security vernacular, Anatomy of IoT cyber atttacks, Physical and hardware security, blockchains and cryptocurrencies in IoT. **IP as IoT Network Layer:**The Business case for IP,The need for optimization, optimizing IP for IOT,Formal risk analysis structures: OCTAVE and FAIR,The phased application of security in an operational environment. **Public safety**: Overview, An IoT Blueprint for Public Safety,IoT Public safety Information Processing.	**09**
5	**Data Analytics for IoT :V**isualizing the power of Data from IoT:Data analysis, Machine Learning, Model building process,Modeling algorithms, Model Performance, Big data platform, Big data Pipeline. **IoT System Management with NETCONF-YANG:** Need for IoT system Management, SNMP, Network operator requirements, NETCONF,YANG **Artificial Intelligence of Things (AIoT)**: Combining AI with IoT for smarter applications.	**06**
6	**Mining :**Mining today and its challenges, Challenges for IoT in modern mining, An IoT strategy for mining ,An architecture for IoT in Mining. **Advanced Applications of IoT:.** **Home automation, Smart Cities,** Healthcare, **Practical Applications of Edge/Fog Computing,** Agriculture, Logistics,Retail,Smart Medication Management System, Smart Factory System.	**05**
	Total	**39**

Advanced Internet of Things Laboratory ((DJS22DSL7013)	
Exp.	**Suggested experiments**
1	Creating first Raspberry Pi project
2	Publishing Information Using MQTT
3	Creating HTTP Server
4	Creating XMPP sensor server
5	Configuring the IOT Gateway
6	Adding CoAP to our devices
7	Running the IoT Gateway project
8	Set up an IoT device (e.g., ESP8266/ESP32) to publish and subscribe to MQTT messages.
9	Send IoT sensor data to AWS IoT Core and visualize it.
10	Perform real-time processing of sensor data on an edge device.
11	Implement SSL/TLS encryption in an MQTT-based IoT setup.

12	Control access to IoT devices using authentication mechanisms.
13	Process real-time traffic data at the fog layer instead of the cloud.
14	Collect and analyse heart rate data from a wearable IoT device.
15	Demonstrate the vulnerability of insecure OT protocols.
16	Store IoT data on a blockchain to ensure immutability.
17	Detect unusual patterns in IoT sensor data using AI.

Minimum eight/ten 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 Assignment/Quizzes (10m).

Books Recommended:

Text Books:

1. David Hanes,Gonzalo Salgueiro,Patrick Grossetete,,Rob Barton,Jerome Henry"IoT Fundamentals",Cisco Press ,June 2017.
2. Shriram Vasudevan, Abhishek Nagarajan,"Internet of Things",Wiley,2nd Edition.
3. Arshdeep Bagha, Vijay Madisetti, "Internet of Things", Universities Press.
4. Peter Waher,"Mastering Internet of Things",Published by Packt.
5. Advanced IoT Technologies and Applications in the Industry 4.0 Digital Economy, CRC Press ,2024
6. "Internet of Things: Technological Advances and New Applications, Apple Academic Press,2024

Reference Books:

1. Smart Home and Industrial IoT Devices: Critical Perspectives on Cyber Threats, Frameworks, and Protocols, Bentham Science Publishers,2024
2. IoT Security: Advances in Authentication, Springer,2023

Web Links:

1. Introduction to internet of things By Prof. Sudip Misra , IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2. Introduction To Industry 4.0 And Industrial Internet Of Things By Prof. Sudip Misra , IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_cs43/preview
3. https://thingspeak.mathworks.com/
4. https://app.arduino.cc/iot/

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

Course: Adversarial Machine Learning (DJS22DSC7014)

Adversarial Machine Learning Laboratory ((DJS22DSL7014)

Pre-requisite: Mathematics for Intelligent System, Machine Learning – I, Information Security.

Course Objectives:

The Course provide an in-depth understanding of adversarial machine learning (AML), focusing on the security vulnerabilities of machine learning models and defenses against adversarial attacks. Students will explore foundational concepts in supervised, unsupervised, and reinforcement learning, along with adversarial settings in each. The course will cover various categories of attacks, including causative and evasion attacks, and introduce frameworks for secure learning. Through case studies and hands-on implementations, students will analyze real-world AML applications in cybersecurity, computer vision, and NLP. The course will also explore open challenges, defensive strategies, and applications beyond security, such as model programming and data augmentation.

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

1. Analyze and apply fundamental machine learning and deep learning techniques to adversarial settings, understanding their vulnerabilities and potential threats.
2. Identify and categorize different adversarial attacks on machine learning models, evaluating their impact on security-critical applications.
3. Assess and compare various defense strategies against adversarial attacks, demonstrating an understanding of security frameworks for robust learning models.
4. Investigate real-world applications of adversarial machine learning in cybersecurity, autonomous systems, and NLP, proposing innovative defensive mechanisms based on research findings.

Adversarial Machine Learning (DJS22DSC7014)		
Unit	**Description**	**Duration**
1	**Machine Learning Preliminaries** Supervised Learning, Supervised Learning in Adversarial Settings, Unsupervised Learning, Unsupervised Learning in Adversarial Settings, Reinforcement Learning in Adversarial Settings, Categories of Attacks on Machine Learning Deep Learning Overview: Machine learning basics, Introduction to deep learning, Elements of neural networks (NNs), Training NNs, NN architectures **Introduction to Adversarial Machine Learning**: Adversarial Machine Learning Taxonomy and History, Statistical Machine Learning, A Framework for Secure Learning: Analyzing the Phases of Learning, Framework, Security Analysis, Exploratory Attacks, Causative Attacks.	**05**

2	**Causative Attacks on Machine Learning**: Availability Attack Case Study: SpamBayes, The SpamBayes Spam Filter, Threat Model for Spam Bayes, The Reject on Negative Impact (RONI) Defense Causative Attacks on Machine Learning: Integrity Attack. **Case Study**: PCA Detector, PCA Method for Detecting Traffic Anomalies, Corrupting the PCA Subspace, Corruption-Resilient Detectors.	**08**
3	**Evasion Attacks:** Evasion Attacks against White box: Fast gradient sign method (FGSM) attack. Projected gradient descent (PGD) attack, DeepFool attack Black box adversarial attacks: Query based attacks, Transfer based attacks (or transferability attacks, Attacks on Real Models. **Defences Against Evasion Attacks: Adversarial** examples detection, Gradient masking/obfuscation, Robust optimization.	**08**
4	**Adversarial Machine Learning in Cyber Security**: Malware Detection and Classification: Machine Learning in cybersecurity, Taxonomy of AML attacks in cybersecurity, Malware detection and classification, Adversarial attacks on ML-based malware classifiers, Malware Detection and Classification. **Network Intrusion Detection**: Network intrusion detection, Datasets for network intrusion detection, Anomaly detection with Machine Learning, Adversarial attacks on ML-based NIDS.	**08**
5	**Adversarial Machine Learning Challenges:** Discussion and Open Problems, Unexplored Components of the Adversarial Game, Development of Defensive Technologies.	**05**
6	**Practical Applications**: Adversarial Machine Learning in Computer Vision, Adversarial Machine Learning in Natural Language Processing (NLP), Adversarial Machine Learning in Autonomous Systems. **Applications beyond attack and defence**: Model Programming, Contrastive explanations, model watermarking and fingerprinting, Data augmentation for unsupervised Learning.	**05**
	Total	**39**

Adversarial Machine Learning Laboratory (DJ19DSL7014)	
Exp.	**Suggested experiments**
1	Implement non-targeted white-box evasion attacks against the deep learning models: Fast Gradient Sign Method (FGSM), and Projected Gradient Descent (PGD).
2	Implement targeted white-box evasion attacks against the deep learning models.
3	Implement a PGD attack on the DL model ResNet50, and investigate if the adversarial examples transfer to the other conventional ML models.
4	Implement a non-targeted PGD attack on the logistic regression model for the set of 120 images.
5	Implement adversarial defenses for white-box evasions attacks against deep learning-based classification models.

6	Get familiar with ML classification models used in cybersecurity applications and implement adversarial attacks against such models.
7	Attacks on ML systems for Network Intrusion Detection
8	Attacks on ML systems for Malware Detection
9	ML systems for Spam Filtering
10	Mini Project

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

Books Recommended:

Text Books:

1. Anthony D. Joseph, Blaine Nelson, "Adversarial Machine Learning", © Cambridge University Press 2019, ISBN: 978-1-107-04346-6.
2. A. Zhang, Z. Lipton, and A. Smola, "Dive into Deep Learning".
3. Soma Halder, "Hands-On Machine Learning for Cybersecurity: Safeguard your system by making your machines intelligent using the Python ecosystem", Packt Publishing ltd.

Reference Books:

1. Yevgeniy Vorobeychik and Murat Kantarcioglu, "Adversarial Machine Learning", Copyright © 2018 by Morgan & Claypool.
2. Pin-Yu Chen and Cho-Jui Hsieh, "Adversarial Robusteness for MAchine Learning", Academic Press an imprint of Elsevier.
3. Shuhe Wang, Kuan-Chieh Wang**, "Adversarial Machine Learning"** Springer Series in Advanced Machine Learning.

Web Links:

1. Goodfellow (2014) Explaining and Harnessing Adversarial Examples)
2. Carlini (2017) Towards Evaluating the Robustness of Neural Networks
3. Brendel (2017) Decision-Based Adversarial Attacks: Reliable Attacks Against Black-Box Machine Learning Models
4. Bhagoji (2017) Exploring the Space of Black-box Attacks on Deep Neural Networks
5. Xu (2019) Adversarial Attacks and Defenses in Images, Graphs and Text: A Review
6. Tramer (2018) Ensemble Adversarial Training: Attacks and Defenses
7. Rosenberg (2021) Adversarial Machine Learning Attacks and Defense Methods in the Cyber Security Domain
8. Severi (2021) Explanation-Guided Backdoor Poisoning Attacks Against Malware Classifiers
9. Kuleshov (2018) Adversarial Examples for Natural Language Classification Problems
10. Erba (2019) Constrained Concealment Attacks against Reconstruction-based Anomaly Detectors in Industrial Control Systems

INSTITUTE LEVEL ELECTIVES

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

Course: Product Life Cycle Management (DJS22ILO7011)

Pre-requisite: Knowledge of basic concepts of Management.

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

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

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Product Life Cycle Management (DJS22ILO7011)		
Unit	**Description**	**Duration**
1	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	**09**
2	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process.	**08**

3	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation **Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies	**08**
4	**Integration of Environmental Aspects in Product Design:** Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.	**07**
5	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	**07**
	Total	**39**

Books Recommended:

Text books:

1. Product Lifecycle Management: Paradigm for 21st Century Product Realization, John Stark, Springer-Verlag, 2004.
2. Product Design for the environment-A life cycle approach, Fabio Giudice, Guido La Rosa, Antonino Risitano, Taylor & Francis 2006.

Reference Books:

1. Product Life Cycle Management‖, Saaksvuori Antti, Immonen Anselmie, Springer, Dreamtech.
2. Product Lifecycle Management: Driving the next generation of lean thinking, Michael Grieve, Tata McGraw Hill, 2006.
3. Product Life-Cycle Management: Geometric Variations, François Villeneuve, Luc Mathieu, Max Giordano, Wiley, 2010.

Prepared by Checked by Head of the Department Principal

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

Course: Management Information System (DJS22ILO7012)

Course Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needsof the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

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

1. Explain how information systems Transform Business.
2. Identify the impact information systems have on an organization.
3. Describe IT infrastructure and its components and its current trends.
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making.
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.

Management Information System (DJS22ILO7012)		
Unit	**Description**	**Duration**
1	**Foundation Concepts:** Information Systems in Business, Functional Area Information System**,** The Components of Information Systems**,** Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.	**03**
2	Information Technologies: Hardware and Software Computer Systems: End User and Enterprise Computing Computer Peripherals: Input, Output, and Storage Technologies Application Software: End User Applications System Software: Computer System Management Data Resource Management: Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management Networks: The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models	**07**
3	**MIS Tools and applications for Decision making:** ERP and ERP support of Business Process Reengineering, **Business intelligence (BI):** Managers and Decision Making, BI for Data analysis and Visualization **Artificial Intelligence Technologies in Business**	**08**
4	**Security and Ethical Challenges:** Security, Ethical, and Societal Challenges of IT Security Management of Information Technology	**06**
5	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.	**07**

6	**Information System within Organization:** Acquiring Information Systems and Applications: Various System development life cycle models. **Enterprise and Global Management of Information Technology:** Managing Information Technology, Managing Global IT.	**08**
	Total	39

Books Recommended:

Reference Books:

1. Management Information Systems, 11th edition by James A O'Brien, George M., Ramesh Behl.
2. Kelly Rainer, Brad Prince, Management Information Systems, Wiley.
3. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
4. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

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

Course: Operations Research (DJS22ILO7013)

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

Course Objectives:

1. To formulate a real-world decision problem as a mathematical programming model.
2. To learn the mathematical tools that are employed to solve mathematical programming models.

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

1. Convert a real-world problem in to a Linear Programming Problem and analyse the solution obtained using Simplex method or other algorithms.
2. Identify real-world problems as Transportation Problem and Assignment Problem and Solve the decision problem by choosing appropriate algorithm.
3. Identify the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.
4. Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.
5. Understand the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.
6. Describe concept of simulation and apply Monte Carlo Simulation technique to systems such as inventory, queuing and recommend solutions for them.
7. Understand need for right replacement policy and determine optimal replacement age.

Operations Research (DJS22ILO7013)		
Unit	**Description**	**Duration**
1	**Introduction to Operations Research:** Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization, **Linear Programming Problem:** Mathematical Formulation. Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.	**10**
2	**Assignment Problems:** Mathematical Formulation, Finding optimal solution - Hungarian Method **Transportation problem:** Mathematical Formulation, Finding initial basic feasible solution – Northwest corner rule, row minima, column minima, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Improving the solution.	**08**
3	**Dynamic Programming**: Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem	**05**

4	**Queuing Models:** Characteristics of queuing models. Single Channel – Single and multi-phase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity. Multichannel – Single phase server - Poisson arrivals, exponential service time with infinite population. **Game Theory:** Introduction. Minimax & Maximin Criterion and optimal strategy. Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle. Approximate methods - Iterative method, m x 2 & 2 x n games -Graphical method and method of sub-games. Expressing game as LPP.	**10**
5	**Simulation:** Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages. **Replacement Models:** Replacement of items that deteriorate with time - when money value is not counted and counted, Replacement of items that fail suddenly – individual and group replacement policy.	**06**
	Total	**39**

Books Recommended:

Text books:

1. Operations Research, Sharma J. K., Trinity Press
2. Operations Research, Gupta P. K., Hira D. S., S. Chand Limited

Reference Books:

1. Operations Research - An Introduction; Taha, H.A.; Prentice Hall
2. Operations Research: Principles and Practice; Ravindran, A, Phillips, D. T and Solberg, J. J.; John Willey and Sons
3. Introduction to Operations Research; Hiller, F. S. and Liebermann, G. J.; Tata McGraw Hill
4. Operations Research Principles and Practice; Pradeep Prabhakar Pai; Oxford University Press
5. Operations Research, R. Panneerselvam, PHI Publications.
6. Operations Research, A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education.
7. Operations Research; Kanti Swarup, P. K. Gupta and Man Mohan; Sultan Chand & Sons

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

Course: Cyber Security and Laws (DJS22ILO7014)

Course Objectives:

1. To understand and identify different types cybercrime and cyber offences.
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

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

1. Understand the different types of cybercrime and security issues E Business.
2. Analyses different types of cyber threats and techniques for security management.
3. Explore the legal requirements and standards for cyber security in various countries to regulate cyberspace.
4. Impart the knowledge of Information Technology Act and legal frame work of right to privacy, data security and data protection.

Cyber Security and Laws (DJS22ILO7014)		
Unit	**Description**	**Duration**
1	**Introduction to Cybercrime**: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus & Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow,, Phishing Identity Theft (ID Theft) ,How criminal plan the attacks, Social Engineering, Cyber stalking .	**10**
2	**Cyber Threats Analysis** Knowledge of Dynamic and Deliberate Targeting Knowledge of Indications and Warning Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions Knowledge of Key Cyber Threat Actors and their Equities Knowledge of Specific Target Identifiers and Their Usage	**06**
3	**Electronic Business and legal issues** Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E-Cheque, E-Cash, E-Payment, Threats & Protections, Security for E-Commerce.	**06**

4	**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, The Intellectual Property Aspect in Cyber Law ,The Evidence Aspect in Cyber Law ,The Criminal Aspect in Cyber Law.	**08**
5	**Security Industries Standard Compliances** IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI-DSS. OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet Security Controls).	**09**
	Total	**39**

Books Recommended:

Reference Books:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. E-Commerce Security and Privacy", Anup K. Ghosh, Springer Science and Business Media, 2012
5. Izzat Alsmadi , The NICE Cyber Security Framework Cyber Security Intelligence and Analytics, Springer
6. Cyber Law & Cyber Crimes, Advocate Prashant Mali; Snow White Publications, Mumbai
7. Nina Godbole, Information Systems Security, Wiley India, New Delhi
8. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
9. William Stallings, Cryptography and Network Security, Pearson Publication
10. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
11. Website for more information, A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

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

Course: Personal Finance Management (DJS22ILO7015)

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

Course Objectives:

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familarise the students with microfinance for accelerating the expansion of local microbusinesses.

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

1. Use a framework for financial planning to understand the overall role finances play in his/her personal life.
2. Compute income from salaries, house property, business/profession, capital gains and income from other sources.
3. Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.
4. Understand how Microfinance can help in financial inclusion.

Personal Finance Management (DJS22ILO7015)		
Unit	**Description**	**Duration**
1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion. **Introduction to Personal Finance** Person Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.	**07**
2	**Personal Financial Management** **Loans:** Home, Car, Education, Personal, Loan against property and Jewel loan. **Insurance:** Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance. **Investment:** Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning for the Future.	**07**
3	**Income Tax** **Income Tax Act Basics**- Introduction to Income Tax Act, 1961 **Heads of Income and Computation of Total Income and Tax Liability**- Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons. **Tax Management, Administrative Procedures and ICDS** - TDS, TCS and Advance Tax Administrative Procedures, ICDS.	**07**

4	**Goods and Services Tax** GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration. **Levy and Collection of GST** Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services	**09**
5	**Introduction to Micro – finance** Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinance, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation & Operation of Self Help Groups (SHGs). **Models in Microfinance -** Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges, **Institutional Mechanism** Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints & Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand & Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs.	**09**
	Total	**39**

Books Recommended:

Reference Books:

1. Banking and Financial Sector Reforms in India , by Asha Singh, M.S. Gupta, Serials Publication.
2. Indian Banking Sector: Essays and Issues (1st) , by M.S. Gupta & J.B. Singh, Serials Publication.
3. Basics Of Banking & Finance , by K.M. Bhattacharya O.P. Agarwal , Himalaya Publishing House
4. Agricultural Finance And Management, by S. Subba Reddy , P. Raghu Ram .
5. The Indian Financial System And Development , by Dr.Vasant Desai, Himalaya Publishing House; Fourth Edition
6. Income Tax Management , Simple Way of Tax Management, Tax Planning and Tax Saving, By Sanjay Kumar Satapathy
7. Direct Tax System Income Tax by Dr. R. K. Jain, SBPD Publications.
8. Simplified Approach to GST Goods and Services Tax, By S K Mishra , Educreation Publishing.
9. Introduction To Microfinance , By Todd A Watkins , World Scientific Publishing Company

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

Course: Energy Audit and Management (DJS22ILO7016)

Course Objectives:

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

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

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.
5. To analyze the data collected during performance evaluation and recommend energy saving measures.

Energy Audit and Management (DJS22ILO7016)		
Unit	**Description**	**Duration**
1	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.	**05**
2	**Energy Audit:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit. **Financial analysis techniques:** Simple payback period, NPV, Return on investment (ROI) Internal rate of return (IRR).	**09**
3	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial	**10**

	drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
4	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation- types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.	**09**
5	**Energy conservation in Buildings**: Energy Conservation Building Codes (ECBC):Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.	**06**
	Total	**39**

Books Recommended:

Reference Books:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science.
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System.
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons.
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B. Smith, Pergamon Press.
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press.
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press.
8. *www.energymanagertraining.com*
9. *www.bee-india.nic.in*

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

Course: Disaster Management and Mitigation Measures (DJS22ILO7017)

Course Objectives:

1. To provide basic understanding hazards, disaster 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 organization 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.

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

1. Know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Know the institutional framework and organization structure in India for disaster management and get acquainted with government policies, acts and various emergency laws.
3. Get to know the simple dos and don'ts in such extreme events and build skills to respond accordingly.
4. Understand the importance of disaster prevention and various mitigation measure with the exposure to disasters hotspots across the globe.

Disaster Management and Mitigation Measures (DJS22ILO7017)		
Unit	**Description**	**Duration**
1	**General Information about Disaster:** Brief concept of Hazards, definition and types of Disasters – Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters, Impact of disaster on National development. 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, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	**09**
2	**Disaster Management:** Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc.Prior, During and Post disaster management activities: (Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration.	**08**

3	**Institutional framework and Mechanism for disaster management in India:** Institutions in India for dealing with various disasters, Organizational structure, functions and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster, NGO's involved in disasters and their task, Jobs carried out by armed forces. Financial Relief During disaster (State, National and International Disaster Assistance)	**07**
4	**Disaster risk reduction and Mitigation Measures:** Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction. Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc. Use of information management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.	**08**
5	**Case studies on disaster (National /International):** Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on. (Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)	**07**
	Total	**39**

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

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

Course: Science of Well-being (DJS22ILO7018)

Course Objectives:

1. To create consciousness about importance of holistic health and physical as well as mental well-being.
2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
3. To introduce the learners to the means of mental and physical well-being, ill effects of mal-practices like alcoholism, smoking etc.
4. To equip the learners to manage and cope up with stress in their daily living.

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

1. Describe concepts of holistic health and well-being, differentiate between its true meaning and misconceptions and understand the benefits of well-being.
2. Recognize meaning of happiness, practice gratitude and self-compassion and analyze incidents from one's own life.
3. Understand the causes and effects of stress, identify reasons for stress in one's own surrounding and self.
4. Recognize the importance of physical health and fitness, assess their life style and come up with limitations or effectiveness.
5. Inspect one's own coping mechanism, assess its effectiveness, develop and strategize for betterment and execute it.

Science of Well-being (DJS22ILO7018)		
Unit	**Description**	**Duration**
1	**Health and well-being:** The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being. Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.	**06**
2	**Concepts of happiness:** Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.	**08**
3	**Stress and mental health/well-being**: Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress. Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.	**09**

4	**Physical Well-being / Health management:** concept of health behaviours, dimensions of health behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, concept of Malnutrition, Health compromising behaviours: Alcoholism, Smoking and its effects on health.	**08**
5	**Dealing with Difficult Times / Coping mechanisms:** The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders. Concept of coping, Ways of coping and stress management, basic knowledge about stress management, various techniques of stress management, stress management programs. Mental strengths and virtues, Hope, Optimism, Resilience – concept, pathways and models, Meditation and Self-introspection.	**08**
	Total	**39**

Books Recommended:

Textbooks:

1. The Science of well-being by Felicia Huppert, Nick Baylis, Barry Keverne; Oxford University Press
2. Health and Well-Being: Emerging Trends by S. Ojha, U. Rani Srivastava, Shobhna Joshi, Global Vision Publishing House
3. Positive psychology: The scientific and practical explorations of human strengths by Shane J. Lopez, Jennifer Teramoto Pedrotti, Charles Richard Snyder; Sage Publications.

Reference Books:

1. The pursuit of happiness and the realization of sympathy: Cultural patterns of self, social relations, and well-being by Kitayama, S., & Markus, H. R, Culture and subjective well-being, The MIT Press.
2. Man Adapting by Dubos, R; New Haven: Yale University Press.
3. Happiness a history by McMahon D. M., Atlantic Monthly Press.
4. Well-being: The foundations of hedonic psychology by D. Kahneman & E. Diener & N. Schwarz, New York: Russell Sage
5. Selye H. The Stress of Life. New York; McGraw-Hill; 1984.

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

Course: Research Methodology (DJS22ILO7019)

Pre-requisites: Basic Knowledge of Probability and Statistics.

Course Objectives:

1. To understand Research and Research Process
2. To acquaint learners with identifying problems for research and develop research strategies
3. To familiarize learners with the techniques of data collection, analysis of data and interpretation

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

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings
5. Write report about findings of research carried out.

Research Methodology (DJS22ILO7019)		
Unit	**Description**	**Duration**
1	**Basic Research Concepts** Meaning of research, Objectives of research, Types of research, Significance of research Research process	**07**
2	**Research Methodology:** Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.	**09**
3	**Research and Sample Design:** Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs	**09**
4	**Data Collection and Data Analysis:** Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data	**09**
5	**Interpretation and Report Writing:** Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues	**05**
	Total	**39**

Books Recommended:

Reference Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd Edition), Singapore, Pearson Education

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

Course: Public Systems and Policies (DJS22ILO7020)

Pre-requisites: Basic Knowledge of Social science and Current affairs

Course Objectives:

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
2. To understand public systems in a fast-changing environment in the global context.
3. To provide an in-depth understanding of the ills prevailing in the society and aids to identify the solutions for them.
4. To explain public policy and its operations with special focus on policy relating to Government finance.
5. To analyze and evaluate the impact of the public policy on firms and economy at large.

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

1. Understand the importance of public systems in a fast-changing environment in the global context.
2. Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
3. Explain public policy and its operations with special focus on policy relating to Government finance.
4. Make policies and know about the happenings in the world, in the nation and those in their locality.
5. Analyze and evaluate the impact of the public policy on firms and economy at large and work under various fields as policymakers.

Public Systems and Policies (DJS22ILO7020)		
Unit	**Description**	**Duration**
1	**Introduction and Overview of Public Systems:** Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.	**09**
2	**Public Sector in the Economics Accounts:** Public Sector in the circular flow; Public Sector in the National Income Accounts.	**06**
3	**Public Choice and Fiscal Politics:** Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.	**07**
4	**Introduction and Overview of Public Policy:** Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.	**11**

5	**Case Studies in Expenditure Policy: Public Services** A) National Defense B) Highways C) Outdoor Recreation D) Education	**06**
	Total	**39**

Books Recommended:

Reference Books:

1. Introduction to Public Policy by Charles Wheelan, W.W. Norton & Company.
2. Understanding Public Policy by Thomas R. Dye, Prentice Hall.
3. Public Policy-Making: An Introduction by Anderson J.E., Boston, Houghton.
4. Public Administration by Avasthi & Maheshwari, Lakshminarayan Agarwal, Agra.
5. New Horizons of Public Administration by Bhattacharya, Mohit, Jawahar Publishers, New Delhi.
6. Public Administration and Public Affairs by Henry, Nicholas, Prentice Hall of India, New Delhi.
7. Public Finance 10th Edition by Harvey S Rosen and Ted Gayer, McGraw-Hill Education, 2013.
8. Public Finance in Theory and Practice by Musgrave and Musgrave.

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

Course: Project Stage – I (DJS22DSP704)

Course 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.

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

1. Discover potential research areas in the field of Data Science.
2. Survey several available literatures in the related field of study.
3. Compare the several existing solutions for research challenges.
4. Design the solution for the research plan.
5. Summarize the findings of the study conducted.
6. Work effectively as a member of the team.

Guidelines:

1. The department must allocate 1 day in the VII semester every week.
2. The project work is to be conducted by a group of 3-4 students.
3. Each group shall identify a potential research area/problem domain, on which the study is to be conducted and submit three proposals to the department.
4. Department will evaluate all the proposals and select the best proposal from each group. Every group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
5. Students will do a rigorous literature survey of the problem domain by reading and understanding at least 10-12 research papers from current superior quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented and research gaps should be identified.
6. Students will design and implement (30-40%) the system in Semester VII.
7. Students will have to regularly submit their project completion tasks given by the department. Each task will be having weightage in the term work.
8. The project assessment for term work will be done based on regular submission of project tasks and presentation at the department level. The Head of the department of respective Program will give the presentation to the panel members, which consist of at least three (3) members as internal examiners (including the project guide/mentor) appointed.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. The term work calculation will be based on plan of data collection (10m), analysis of literature survey (15m), proposed design (15m), documentation and presentation (10m).

Prepared by Checked by Head of the Department Principal