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

Artificial Intelligence (AI) and Data Science

(Semester VII)

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

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

Approved by:- Governing Body of Dwarkadas. J. Sanghvi College of Engineering
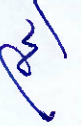
With effect from the Academic Year: 2025-2026

Scheme for Final Year Undergraduate Program in Artificial Intelligence (AI) and Data Science: Semester VII (Autonomous) (Academic Year 2025-26)

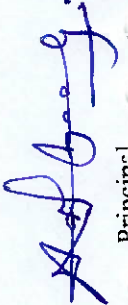| Sr No	Course Code	Course	Teaching Scheme			Continuous Assessment (A)					Semester End Examination (B)						Aggregate (A+B)	Credits
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Term Test 1 (TT1)-a	Term Test 2 (TT2)-b	Total	Term work	CA Total	Duration	Theory	Oral	Pract	Oral & Pract	SEE Total		
1	DJS22ADC701	Time Series Analysis and Forecasting	3	--	--	20	15	35	--	35	2	65	--	--	--	65	100	3
	DJS22ADL701	Time Series Analysis and Forecasting Laboratory	--	2	--	--	--	--	25	25	--	--	25	--	--	25	50	1
2	DJS22ADC702	Large Language Models	3	--	--	20	15	35	--	35	2	65	--	--	--	65	100	3
	DJS22ADL702	Large Language Models Laboratory	--	2	--	--	--	--	25	25	--	--	25	--	--	25	50	1
3	DJS22ADL703	Applied Data Science Laboratory	--	2	--	--	--	--	25	25	--	--	25	--	--	25	50	1
	DJS22ADC7011	Explainable AI	3	--	--	20	15	35	--	35	2	65	--	--	--	65	100	3
	DJS22ADL7011	Explainable AI Laboratory	--	2	--	--	--	--	25	25	--	--	25	--	--	25	50	1
4	DJS22ADC7012	Probabilistic Graph Models	3	--	--	20	15	35	--	35	2	65	--	--	--	65	100	3
@	DJS22ADL7012	Probabilistic Graph Models Laboratory	--	2	--	--	--	--	25	25	--	--	25	--	--	25	50	1
	DJS22ADC7013	Blockchain Technology	3	--	--	20	15	35	--	35	2	65	--	--	--	65	100	3
	DJS22ADL7013	Blockchain Technology Laboratory	--	2	--	--	--	--	25	25	--	--	25	--	--	25	50	1
5#	DJS22ILO7011	Product Lifecycle Management	3	--	--	20	15	35	--	35	2	65	--	--	--	65	100	3
	DJS22ILO7012	Management Information System																
	DJS22ILO7013	Operations Research																
	DJS22ILO7014	Cyber Security and Laws																
	DJS22ILO7015	Personal Finance Management																
	DJS22ILO7016	Energy Audit and Management																
	DJS22ILO7017	Disaster Management and Mitigation Measures																
	DJS22ILO7018	Science of Well-being																
	DJS22ILO7019	Research Methodology																
	DJS22ILO7020	Public Systems and Policies																
6	DJS22ADP704	Project Stage I	--	4	--	--	--	--	50	50	2	--	--	--	50	50	100	2
		Total	12	12	0	80	60	140	150	290	16	260	100	0	50	410	700	18

@: Department Level Electives, #: Institute Level Electives

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Vice Principal

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Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (mins)
Theory	a. Term Test 1 (based on 40 % syllabus)	20	60
	b. Term Test 2 (on next 40 % syllabus)	15	60
	c. Assignment / course project / group discussion / presentation / quiz/ any other.	--	--
	Total marks (a + b + c)	35	--
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	As applicable
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory and Tutorial	Performance in the laboratory and tutorial.	50	

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work
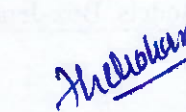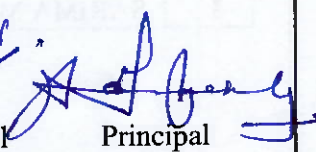
Semester End Assessment (B):

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 and Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the Examination and on the entire syllabus.	As per the scheme	2

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Program: Artificial Intelligence (AI) and Data Science   Final Year B.Tech.   Semester: VII
Course: Time Series Analysis and Forecasting (DJS22ADC701)
Course: Time Series Analysis and Forecasting Laboratory (DJS22ADL701)

Prerequisite: Statistics for Data Science, Machine Learning, Deep Learning

Course Objectives: The objectives of the course are

1. Learn basic analysis of time series data and preprocessing
2. Study classical time series models
3. Learn basic concepts of forecasting.
4. Explore advanced machine learning and deep learning approaches for improving forecasting accuracy

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

1. Explain Time Series Fundamentals and Preprocessing.
2. Analyze Stationary Time Series and Develop Univariate Models
3. Apply Forecasting Techniques for Univariate and Multivariate Time Series
4. Design and Implement Machine and Deep Learning Models for Time Series

Unit No.	Time Series Analysis and Forecasting (DJS22ADC701)	
	Description	**Duration**
1	**Introduction and Stationary Time Series** Formal definition of time series, Interpolation vs Extrapolation, Components of time series (trend, seasonality, noise), Types of time series (discrete, continuous, univariate, multivariate), Models of time series analysis (deterministic vs stochastic models), Types of forecasting methods (qualitative, quantitative, hybrid), Types of time series patterns and different types of data, Simple descriptive techniques and trend identification and measurement. **Preprocessing Techniques:** Handling time series data: working with Date and Time, Handling Missing Data & Outliers: Forward/Backward Fill, Interpolation, Hampel Filter, Z-score, IQR, Time Series Decomposition: Additive and Multiplicative Models, Seasonal-Trend Decomposition using LOESS (STL)	08
2	**Stationary Time Series:** Weak and strict stationarity, Sample mean and its standard error, Correlogram analysis and autocorrelation, Statistical inference of time series: Removing trend, Unit Root Testing Stationarity (ADF and KPSS Tests) and Differencing (First-Order, Seasonal Differencing), **Autocorrelation and Partial Autocorrelation:** Definition and Mathematical Concepts, **ACF and PACF Plots:** Plotting and Interpretation, Identifying AR and MA Orders **Smoothing Techniques:** Smoothing Techniques for Time Series Moving Averages (Simple, Weighted), Exponential Smoothing (SES, Holt's, Holt-Winters).	07
3	**Univariate Time Series:** Autoregressive (AR), Moving Average (MA), theoretical properties of time series with a MA (1) and MA (2) model, simulating from an autoregressive process, ARMA, ARIMA, Unit roots with $|\phi|$, backshift and lag operator, integrated and non-invertible processes, SARIMA Models, Box-Jenkins Methodology for Model Selection	07

4	**Forecasting:** Introduction to Forecasting Concepts: Definition and Types of Forecasting, forecast horizon, Naive Forecasting Methods (simple, seasonal), Forecasting Stationary Time Series, One-Step Ahead Prediction for AR, ARMA, ARIMA Model , MA(∞) representation of AR(1) model, One-step ahead predictors based on the finite past: Durbin-Levinson algorithm	06	
5	**Multivariate Time Series:** Multivariate time series regression: Conditional independence, Partial correlation and coherency between time series, Vector ARIMA Models - Vector AR (VAR) Models **Univariate volatility models:** Univariate ARCH, GARCH (financial volatility modelling)	05	
6	**Machine and Deep Learning for Time Series Forecasting:** Linear regression for time series, Machine Learning methods- windowing, Model Selection & Evaluation: Cross-Validation for Time Series CNN for Time Series Forecasting, Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Attention Mechanisms and Transformers for Time Series, Hybrid Models: Combining ARIMA and LSTM for Forecasting.	06	
	Total	39	

List of Experiments:

1. MiniData Preprocessing: Clean and preprocess a given time series dataset, handling
2. missing values, Outlier Detection using statistical methods.
3. Smoothing techniques
4. Auto regression Models for Time Series Forecasting with Python
5. Apply ARIMA - SARIMA models to predict / forecast the number of
6. passengers travelling using aero planes based on time series data
7. Implement Durbin levinson algorithm for one step ahead forecasting.
8. Implement a multivariate time series regression model.
9. Implement ARCH and GARCH on a financial time series dataset.
10. Time Series Prediction with LSTM Recurrent Neural Networks in Python
11. Implement Anomaly detection using Time series data
12. Compare and contrast on Statistical methods and Deep Learning methods by
13. forecasting the Weekly Rainfall and Temperature.
14. Combine ARIMA with LSTM for improved accuracy.

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

Books Recommended:

Textbooks:

1. Daniel Garfield (Author)Time Series Analysis for Beginners: Comprehensive Introduction Kindle Edition ,May 22, 2024
2. William W. S. Wei, "Time Series Analysis Univariate and Multivariate Methods" May 26, 2023
3. Douglas C. Montgomery, Cheryl L. Jennings and Nurat Kulahci, "Introduction to Time Series Analysis and Forecasting," Second Edition, Wiley, 2015. Wilfredo Palma ,TIME SERIES ANALYSIS, Wiley , B. V. Vishwas and Ashish Patel, "Hands-on Time Series Analysis with Python," First Edition, Apress, 2020
4. James D. Hamilton, "TIME SERIES ANALYSIS" ,Levant Books, 2012
5. Ted Dunning and Ellen Friedman," Time Series Databases: New Ways to Store and Access Data", First Edition, O'Reilly, 2019

Reference Books:

1. Time Series Analysis with Python Cookbook: Practical recipes for exploratory data analysis, data preparation, forecasting, and model evaluation , Packt Publishing, 2022
2. Marc S. Paolella, Linear Models and Time-Series Analysis, Wiley publications
3. Walter Enders," Applied Econometric Time Series," Fourth Edition, Wiley, 2014
4. Chris Chatfield, "Time- Series Forecasting," First Edition, Chapman & Hall/CRC, 2001
5. Aileen Nielsen, "Practical Time Series Analysis," O'Reilly, 2019
6. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications," Springer, 2000
7. R. S. Tsay, Analysis of Financial Time Series, Wiley,2000

Web Links:

1. https://www.coursera.org/learn/practical-time-series-analysis?msockid=0fba0991cc8d64af281a1ae9cd3f657a
2. https://www.coursera.org/learn/illinois-tech-introduction-to-time-series?irclickid=xGjxa83B5xyPUjXVPt3FCX4hUksy38R1qQ47R80&irgwc=1&utm_medium=partners&utm_source=impact&utm_campaign=315774&utm_content=b2c&utm_campaignid=CoToNet%20%20Tecnologias%20de%20Informa%C3%A7%C3%A3o%2C%20Unipessoal%20Lda&utm_term=14726_CR_1213620
3. www.coursera.org/learn/demand-prediction-using-time-series?msockid=0fba0991cc8d64af281a1ae9cd3f657a
4. https://web.stat.tamu.edu/~suhasini/teaching673/time_series.df

Online Resources:

1. Applied Time-Series Analysis By Prof. Arun K. Tangirala | IIT Madras
   Link: Applied Time-Series Analysis - Course
2. Time Series Modelling and Forecasting with Applications in R By Prof. Sudeep Bapat | IIT Bombay
   Link: Time Series Modelling and Forecasting with Applications in R - Course

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Program: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech**   **Semester: VII**

Course: Large Language Models (DJS22ADC702)

Course: Large Language Models Laboratory (DJS22ADL702)

Prerequisite: Natural Language Processing, Deep Learning

Course Objectives: The objectives of the course are

1. Introduce the fundamental concepts and applications of Generative AI.
2. Provide in-depth understanding of Transformer architecture, the core building block of largest Language Models (LLMs).
3. Explore various LLM architectures and techniques like BERT, prompt engineering, and fine-tuning.
4. Introduce students to Multimodal LLMs that can process and understand different data modalities.

Course Outcomes: Students will be able to

1. Describe the fundamental concepts and applications of Generative AI and to provide in-depth understanding of Transformer architecture, the core building block of Large Language Models (LLMs).
2. Analyze various LLM architectures and techniques like BERT, GPT-3, T5 and Large Reasoning Models.
3. Apply prompt engineering techniques for effective LLM interaction and understand the concept of Retrieval Augmented Generation (RAG) and its role in LLMs.
4. Explain the different data modalities using Multimodal Architectures.

Large Language Models (DJS22ADC702)	
Unit No.	**Description**	**Duration**
1	**Introduction to Generative AI and Transformer Architecture** Domains of Generative AI, Text Generation, Image Generation, Music Generation, Video Generation. Limitations of RNN & LSTM, Tokenization, Transformer Architecture : encoders, decoders, attention mechanisms - types, Self-attention vs Flash Attention, feed-forward layer, Reinforcement Learning with AI Feedback (RLAIF), Reinforcement Learning from Human Feedback (RLHF).	08
2	**Language Models - Unveiling the Power of Words** BERT (Bidirectional Encoder Representations from Transformers) and its applications, exploring other notable LLM architectures (e.g. GPT-3, T5), Mixture of Experts (MoE), various benchmarks to evaluate LLMs – perplexity, BLEU score, Needle in a Haystack	06
3	**Large Reasoning Models** Deep seek-v2:Multi head Latent Attention, Deep seek MoE, Knowledge Distillation, Mistral 7-B Architecture: sliding Window attention, Grouped Query Attention, Titans: Learning to memorize at test time, Knowledge Distillation, QWQ models.	05
4	**Prompt Engineering &Agentic AI** Introduction to prompt, examples of prompt, prompt engineering, prompt techniques, zero shot, one shot, few-shot learning, Agentic AI- a chain of thought ReAct , self-consistency, Tree of thought, Multimodal CoT, Graph prompting, Large Action Models(LAMs), LLM based Agents, Auto Gen	06
5	**Retrieval Augmentation & Generation (RAG) and Fine-tuning for LLMs** Understanding Retrieval and vector, vector storage: vector indexing and retrieval Algorithms: Annoy, HSNV, Inverted File System, LSH, vector quantization techniques: Scalar, Product, Binary, vector libraries, vector databases, Loading and retrieving in Lang Chain, Document loaders, Retrievers in Lang Chain. Fine-tuning: Quantization, PEFT, Full-Fine-tuning vs LoRA vs QLoRA, Fine-Tuning LLMs for different downstream tasks.	08

6	**Multimodal Architectures - Beyond Text** Introduction to Multimodal LLMs, Exploring architectures for Multimodal LLMs: Vision Transformer, Next GPT, Applications of Multimodal LLMs (e.g., image captioning, video summarization), Multi-task LLMs, Empowering Time Series Analysis with Large Language Models	**06**
	Total	**39**

List of Experiments:

1. Case study on Applications of Generative AI
2. Case study on role of Artificial Intelligence in achieving the Sustainable Development Goals
3. Fine Tuning Pre-trained Model On Custom Dataset Using Transformer
4. Build your own LLM from scratch.
5. Query PDF using Lang Chain and Pine cone
6. Fine Tune LLAMA 2 With Custom Dataset Using LoRA and QLoRA Techniques
7. Using in-built tools and creating custom tools for ReAct agent in Langchain.
8. Question Answering Application using LLM based agents.
9. Understanding various retrievers in Langchain.
10. Case study on comparison of Large Reasoning Models
11. Understanding multimodal models like Gemini vision
12. Build a simple multimodal generative model that combines text and image inputs to generate captions
13. Mini project
    Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text Books:

1. Ben Auffarth, "Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT, and other LLMs" by Packt Publishing, 2023
2. Valentina Alto, "Modern Generative AI with ChatGPT and OpenAI Models", by Packt Publishing, 2023
3. Jay Alammar, Maarten Grootendorst, "Hands-On Large Language Models", by O'Reilly, 2023
4. Thushan Ganegedara, "Natural Language Processing with TensorFlow", by Packt Publishing, Second Edition, 2022

Reference Books:

1. David Foster, "Generative Deep Learning", O'Reilly, 2020
2. Lewis Tunstall, Leandro von Werra & Thomas Wolf," Natural Language Processing with Transformers", 2022
3. Sebastian Raschka, "Build a Large Language Model (From Scratch)",2021

Web Links:

1. https://huggingface.co/blog/moe
2. https://medium.com/@shivansh.kaushik/efficient-model-fine-tuning-for-llms-understanding-peft-by-implementation-fc4d5e985389
3. https://humanloop.com/blog/llm-benchmarks
4. https://sebastianraschka.com/blog/2023/self-attention-from-scratch.html

5. https://medium.com/@bryan.mckenney/teaching-llms-to-think-and-act-react-prompt-engineering-eef278555a2e
6. https://www.pinecone.io/learn/series/langchain/langchain-agents/
7. https://www.pinecone.io/learn/series/langchain/langchain-agents/

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Program Artificial Intelligence (AI) and Data Science   **Final Year B. Tech.**   **Semester: VII**
Course: Applied Data Science Laboratory (DJS22ADL703)

Prerequisite: Statistics for Data Science, Fundamentals of Machine learning

Course Objectives: The objectives of course are

1. To develop practical skills in advanced data science techniques, including supervised and unsupervised learning, big data tools, and cloud-based machine learning deployment.
2. To enable students to build responsible and real-time AI solutions through hands-on experimentation with edge AI systems and ethical AI practices for solving real-world data challenges.

Course Outcomes: Students will be able to,

1. Apply supervised learning techniques including AutoML, hyperparameter tuning, and model.
2. Implement unsupervised, semi-supervised, and Agentic AI Systems for real-world data scenarios.
3. Use big data and cloud tools for large-scale data processing and ML model deployment.
4. Develop explainable, fair, and real-time AI systems using edge and streaming technologies.

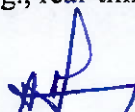| Applied Data Science Laboratory (DJS22ADL703)		
Unit No.	Description	Duration
1	**Advanced Supervised Learning Techniques:** Class Imbalance Handling: SMOTE, ADASYN, and cost-sensitive learning. Automated Machine Learning (AutoML): Overview of AutoML frameworks (e.g., H2O, Auto-sklearn) Hyperparameter Tuning: Grid Search, Random Search, Bayesian Optimization.	04
2	**Advanced Unsupervised and Semi-Supervised Learning:** Anomaly Detection: Techniques: Isolation Forests, One-Class SVM, Autoencoder-based methods, Applications in fraud detection and healthcare, **Semi-Supervised Learning: Techniques:** Self-training, Co-training, Graph-based SSL, Applications in low-labeled data scenarios. **Agentic AI Systems:** Defining "Agentic AI": Characteristics and scope, Intelligent Agent Architecture (Perception → Decision → Action), Types of Agents: Reactive, Deliberative, Hybrid.	06
3	**Real-Time Image Dataset Creation & Diversity Strategies:** Techniques for capturing real-time image data using cameras and mobile devices, Principles of dataset diversity: lighting, angles, backgrounds, demographics, and object variability, Data augmentation methods for enhancing dataset variety (rotation, zoom, brightness shift, etc.), Identifying and mitigating dataset bias in image-based AI systems	05
4	**Explainability & Ethical Decision-Making in Agentic AI:** Why Explainability Matters in Agentic Systems, Overview of SHAP, LIME, Integrated Gradients, Introduction to Fairness in AI: Disparate impact, pre/post-processing mitigation, Case studies: AI bias in lending, hiring, facial recognition, Explainability in, Decision-making agents, Responsible Agentic AI Toolkits: IBM AI Explainability 360, Google's What-If Tool.	06
5	**Real-Time & Edge Agentic Systems:** Real-Time Agent Design: Continuous sensing and streaming data handling, Edge AI Deployment: TensorFlow Lite, ONNX, and Edge Impulse, Stream Processing Overview: Apache Kafka and Spark Streaming basics, Building autonomous image classification agents for mobile or embedded devices.	05
	Total	26

List of Experiments:

1 Handling Class Imbalance Using SMOTE and ADASYN
   Tools: imbalanced-learn, scikit-learn

Dataset: Credit Card Fraud / Breast Cancer Dataset

Objective: Apply and compare SMOTE and ADASYN oversampling strategies.

2 AutoML for Model Selection and Training

Tools: Auto-sklearn / H2O AutoML

Objective: Run AutoML on a classification dataset to evaluate accuracy and pipeline choice.

3 Hyperparameter Optimization Techniques

Tools: GridSearchCV, RandomizedSearchCV, Optuna

Objective: Tune hyperparameters of RandomForest/SVM using Grid, Random, and Bayesian methods.

4 Anomaly Detection using Isolation Forest and One-Class SVM

Tools: scikit-learn

Dataset: Credit card or network intrusion dataset

Objective: Identify anomalies using tree-based and margin-based methods.

5 Autoencoder for Anomaly Detection

Tools: Keras / PyTorch

Objective: Build an autoencoder to reconstruct and detect anomalies in MNIST or ECG data.

6 Semi-Supervised Learning via Self-Training and Co-Training

Tools: scikit-learn

Objective: Use partial labels on a dataset and implement self-training and co-training methods.

7 Designing a Basic Agent Architecture (Perception → Decision → Action)

Tools: Python (custom code)

Objective: Simulate a hybrid agent that processes input, makes a decision, and performs an action.

8 Capture and Preprocess Real-Time Images Using Webcam/Mobile

Tools: OpenCV, Android Studio/Google Colab

Objective: Collect face or object images using camera APIs and preprocess them.

9 Data Augmentation Techniques for Visual Diversity

Tools: imgaug, albumentations, TensorFlow/Keras

Objective: Apply rotation, brightness, zoom, flip, and noise to enhance training data.

10 Bias Detection in Image Dataset

Tools: AI Fairness 360 / manual inspection

Dataset: FairFace or UTKFace

Objective: Analyze and visualize demographic or environmental bias in images.

11 Model Explainability using SHAP and LIME

Tools: SHAP, LIME

Objective: Explain decision-making of a black-box model on tabular/image data.

12 Mitigating AI Bias using Pre/Post Processing

Tools: AIF360 Toolkit

Dataset: COMPAS or Adult Income

Objective: Apply fairness mitigation techniques before and after model training.

13 Explore Explainability using Google What-If Tool

Tools: TensorBoard + WIT plugin

Objective: Visualize how feature changes affect agentic model decisions.

14 Real-Time Streaming Classifier with Kafka and Spark Streaming

Tools: Apache Kafka, Spark Streaming, Python

Objective: Stream simulated sensor/image data and classify in real-time.

15 Deploying an Agentic Image Classifier on Raspberry Pi using TensorFlow Lite

Tools: Raspberry Pi / TensorFlow Lite

Objective: Deploy a CNN model and build an autonomous edge AI agent (e.g., real-time object detector).

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

Books Recommended:

Textbooks:

1. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists",O'Reilly Media, First Edition, 2016.
2. Wes McKinney ,"Python for Data Analysis" by, O'Reilly Media, 2nd Edition, 2017.
3. "Interactive Data Visualization for the Web" by Scott Murray, O'Reilly Media, 2nd Edition, 2017.
4. Markus D. Dubber, Frank Pasquale, Sunit Das, The Oxford Handbook of Ethics of AI, Oxford University Press, 2020.
5. Manuel Kolitsch, Kai Sachs, Real-Time Stream Data Processing: Fundamentals & Use Cases, Springer, 2021.

Reference Books:

1. Aurélien Géron, ""Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow""O'Reilly Media, 3rd Edition, 2022.
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville ,"Deep Learning" by, MIT Press, First Edition, 2016.
3. Sandra Wachter, Brent Mittelstadt, "The Ethics of Algorithms: Mapping the Debate", Oxford Internet Institute, 2021.
4. Ming Chen, Streaming Systems: "The What, Where, When, and How of Large-Scale Data Processing", O'Reilly Media, 1st Edition, 2018.

Web Links:

1. https://realpython.com/beautiful-soup-web-scraper-python/
2. https://www.datacamp.com/tutorial/guide-to-data-cleaning-in-python
3. https://www.geeksforgeeks.org/machine-learning-algorithms/
4. https://learn.microsoft.com/en-us/training/azure/

Online Resources:

1. Diving Deep with Imbalanced Data | DataCamp: https://www.datacamp.com/tutorial/diving-deep-imbalanced-data/
2. Hyperparameter Tuning with Keras Tuner (Coursera): https://www.coursera.org/learn/tensorflow-2-hyperparameter-tuning/
3. Unsupervised Learning in Python (DataCamp): https://learn.datacamp.com/courses/unsupervised-learning-in-python/
4. Anomaly Detection in Time Series Data (Coursera): https://www.coursera.org/learn/anomaly-detection-time-series/
5. Deep Learning Specialization (Coursera): https://www.coursera.org/specializations/deep-learning/
6. Autoencoder Anomaly Detection (YouTube – Nicholas Renotte): https://www.youtube.com/watch?v=9zKuYvjFFS8/
7. Introduction to Semi-Supervised Learning (edX – INRIA): https://www.edx.org/course/semi-supervised-learning/
8. Self-training with Scikit-learn (Kaggle Kernel): https://www.kaggle.com/code/jhoward/self-training/
9. Artificial Intelligence (ColumbiaX on edX): https://www.edx.org/course/artificial-intelligence-ai/
10. Creating Agents in Python (YouTube): https://www.youtube.com/watch?v=JtiK0DOeI4A/

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Program: Artificial Intelligence (AI) and Data Science   Final Year B.Tech.   Semester: VII
Course: Explainable AI (DJS22ADC7011)
Course: Explainable AI Laboratory (DJS22ADL7011)

Prerequisite: Machine Learning, Deep Learning, Python Programming, AI
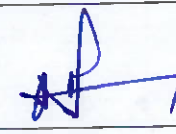
Course Objectives: The objectives of the course are

1. To understand how to explain machine learning models with various techniques
2. To familiarize concepts related to Explainable Artificial Intelligence (XAI) and interpretable methods, with emphasis on how to build a trustworthy AI system
3. To understand the performance of a machine learning model and its ability to produce explainable and interpretable predictions

Course Outcomes: Students will be able to

1. Explain the concept and importance of explainable AI.
2. Compare Interpretability and Explainability in Machine Learning Models.
3. Apply XAI Techniques on Machine Learning Models.
4. Evaluate the Interpretability and Trustworthiness of AI Models.
5. Explain the Role of Attention Mechanisms and Feature Visualization in Deep Learning Models.
6. Apply XAI Techniques in Healthcare and Autonomous Systems.

Unit No.	Description	Duration
	Explainable AI (DJS22ADC7011)	
1	**Introduction to Explainable AI** Explainability – Fundamentals of XAI - Categorization of XAI - Taxonomy of XAI methods for Machine Learning - Machine Learning Interpretability - Causal Model Induction - Causality learning - XAI techniques and limitations	05
2	**Interpretability** Difference between Interpretability and Explainability Interpretability methods to explain Black-Box Model - Scope of Interpretability - Apply interpretability on Regression, Logistic regression, Generalized Additive Models, Decision Tree - Neural network interpretation - Evaluation of Interpretability	06
3	**Deep Explanation** Attention Mechanisms - Modular Networks - Feature Identification - Learn to Explain - Feature Visualization - Deep Visualization gradcam and Activation maps - Sensitivity analysis	05
4	**XAI Model and Methods** Ante-hoc Explainability (AHE) models - Post-hoc Explainability (PHE) models - Interactive Machine Learning (IML) - Black Box Explanation through Transparent Approximation (BETA) models - Hybrid Models. XAI Techniques - Local Interpretable Model-Agnostic Explanations (LIME) - Understanding Mathematical representation of LIME - Shapley Additive exPlanations (SHAP) -Diverse Counterfactual Explanations (DiCE) - Layer wise Relevance Propagation (LRP), Working and principal of Contrastive Explanation Method (CEM)	09

5	**Building Trustworthy Model with Explainable AI** Metrics to evaluate XAI, Trustworthy Explainability Acceptance, Power Quality Disturbance (PQD) classification, Methods for measuring human intelligence. Evaluating AI system. Medical diagnosis- Making AI Decisions Trustworthy for Physicians and Patients – Sales predictions on the house sale	07
6	**Applications** Application of XAI in Healthcare, Explainable AI Driven Applications for Patient Care and Treatment, Explainable Machine Learning for Autonomous Vehicle Positioning Using SHAP	07
	Total	**39**

List of Experiments:

1. Explore how different types of machine learning models (e.g., decision trees, random forests, neural networks) provide different levels of interpretability and explainability.

2. Train a linear regression model and apply coefficients interpretation.

3. Implement a Generalized Additive Model (GAM) for regression and interpret the individual feature effects using partial dependence plots (PDP).

4. Apply sensitivity analysis to a trained model (e.g., random forest or neural network) to identify the most influential features in prediction outcomes.

5. Apply LIME to interpret local model decisions and visualize results.

6. Use SHAP to explain global and local predictions and analyze feature importance.

7. Apply DiCE to generate counterfactual explanations for a black-box model (e.g., customer churn prediction)

8. Test a Power Quality Disturbance (PQD) classification model and evaluate its performance using trustworthiness metrics

9. Use SHAP or LIME to explain the model's predictions and evaluate its trustworthiness for use by financial analysts and investors.

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

Books Recommended:

Textbooks:

1. Molnar, Christoph. "Interpretable machine learning. A Guide for Making Black Box Models Explainable", 2019. https://christophm.github.io/interpretable-ml-book/.

2. Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning, Uday Kamath: John Liu, Springer.

Reference Books:

1. "Explanation in Artificial Intelligence" by Tim Miller, arXiv, 2017

2. "Explainable Artificial Intelligence (XAI) in Biomedicine: Making AI Decisions Trustworthy for Physicians and Patients" by Lötsch, J.; Kringel, D.; Ultsch, A., BioMedInformatics, 2022

3. "A Guide for Making Black-Box Models Interpretable" by Christoph Molnar, GitHub Pages, 2020

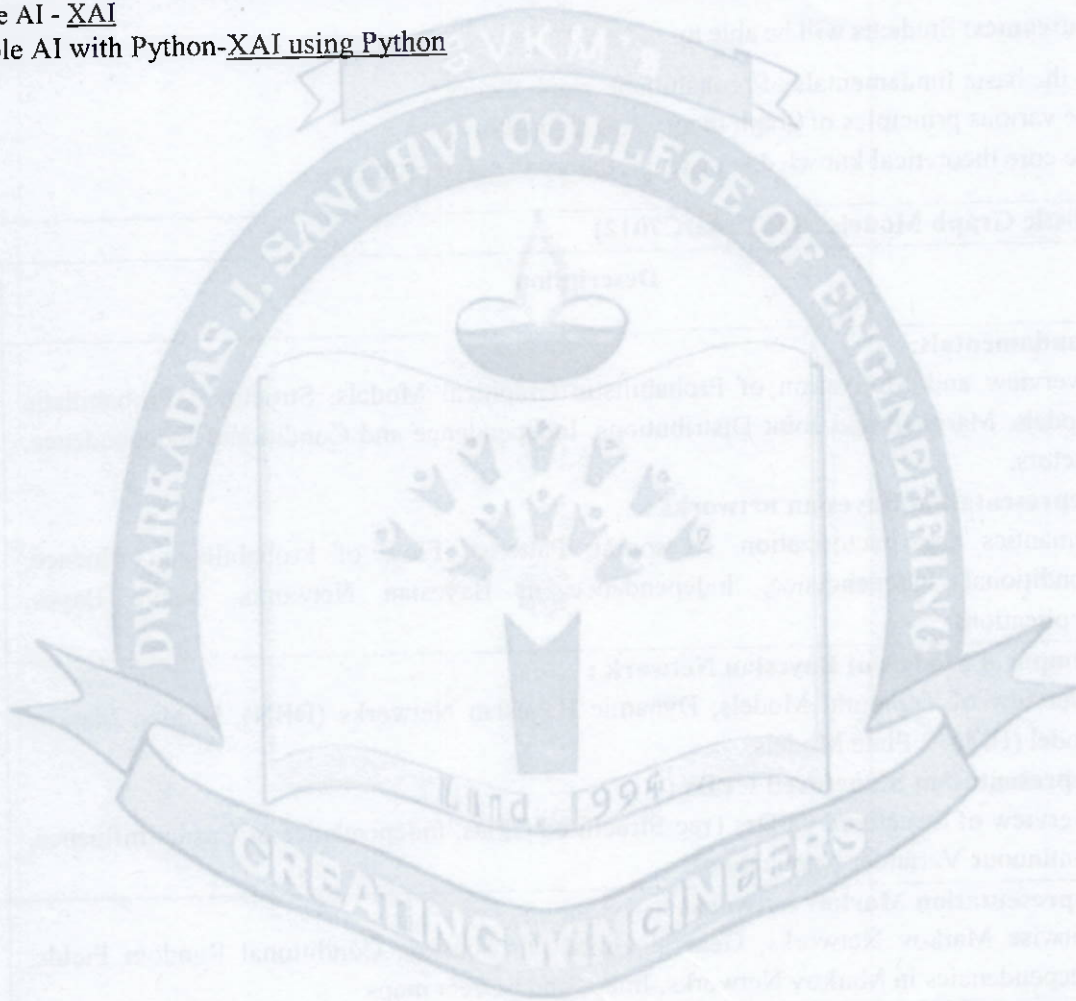## Web Resources:

1. https://arxiv.org/pdf/1902.03076
2. https://christophm.github.io/interpretable-ml-book/
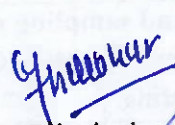3. https://arxiv.org/abs/1610.02391

Online Resources

1. Explainable AI: Interpreting Machine Learning Models Explainable AI: Interpreting Machine Learning Models - Coursera
2. AI in Healthcare: Using Machine Learning AI in Healthcare: Using Machine Learning - Coursera
3. Explainable AI - XAI
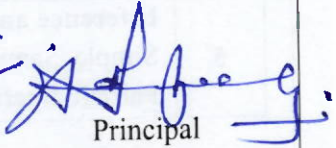4. Explainable AI with Python-XAI using Python

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Program: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech.**   **Semester: VII**
Course: Probabilistic Graph Models (DJS22ADC7012)
Course: Probabilistic Graph Models Laboratory (DJS22ADL7012)

Prerequisite: Machine learning, Probability

Course Objectives: The objectives of this course are

1. To model problems using graphical models
2. To design inference algorithms
3. To learn the structure of the graphical model from data.

Course Outcomes: Students will be able to

1. Explain the basic fundamentals of probabilistic graph theory.
2. Illustrate various principles of graph theory and algorithms.
3. Integrate core theoretical knowledge of graph theory to solve problems.

Probabilistic Graph Models (DJS22ADC7012)		
Unit No.	Description	Duration
1	**Fundamentals:** Overview and Motivation of Probabilistic Graphical Models, Structured Probabilistic Models, Marginal and Joint Distributions, Independence and Conditional Independence, Factors. **Representation Bayesian networks :** Semantics and Factorization, Reasoning Patterns, Flow of Probabilistic Influence, Conditional Independence, Independence in Bayesian Networks, Naïve Bayes, Applications.	05
2	**Temporal Models of Bayesian Network :** Overview of Temporal Models, Dynamic Bayesian Networks (DBN), Hidden Markov Model (HMM), Plate Models. **Representation Structured CPDs :** Overview of Structured CPDs, Tree-Structured CPDs, Independence of Casual Influence, Continuous Variable, Applications.	07
3	**Representation Markov networks :** Pairwise Markov Networks, General Gibbs Distribution, Conditional Random Fields, Independencies in Markov Networks, Imaps and perfect maps	06
4	**Exact inference :** Conditional Probability Queries, MAP Inference, Analysis of Complexity, Sum- and Max-product algorithms, Variable elimination, Belief propagation (message passing) on trees, Clique tree.	06
5	**Inference and sampling methods :** Simple Sampling, MCMC method, Gibbs sampling Algorithm, Importance sampling, Particle filtering.	06

6	**Learning Parameter Estimation :** Learning Overview, Maximum Likelihood Estimation for Bayesian Networks, Bayesian Estimation, Bayesian Prediction, Bayesian Estimation for Bayesian Networks. Maximum Likelihood for Log-Linear Models, Maximum Likelihood for MRFs and CRFs. Structure Learning: Overview, Likelihood Scores, BIC and Asymptotic Consistency, Bayesian Scores, Learning Tree Structured Networks, Learning General Graphs: Heuristic Search	09
	Total	**39**

List of Experiments:

1. Implement Discrete Bayesian Networks
2. Implementation of Alarm Bayesian Network
3. Implementation of Linear Gaussian Bayesian Networks (GBNs).
4. Implementation of Monty Hall Problem using Bayesian Network
5. Implementation of Exact inference in Bayesian Networks.
6. Implementation of Inference in Discrete Bayesian Network
7. Implementation of Causal Inference
8. Implement Approximate Inference using MCMC.
9. Implementation of Parameter Learning in Discrete Bayesian Networks.
10. Mini project

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

Books Recommended:
Textbooks:

1. Koller, D. and Friedman, N. "Probabilistic Graphical Models: Principles and Techniques," MIT Press, 2009

Reference Books:

1. Jensen, F. V. and Nielsen, T. D. "Bayesian Networks and Decision Graphs. Information Science and Statistics," 2nd edition, Springer, 2002
2. Luis Enrique Sucar, "Probabilistic Graphical Models Principles and Application", Advances in Computer Vision and Pattern Recognition, Second Edition, Springer
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective," 4th Printing. MIT Press, 2013
4. Barber, D. "Bayesian Reasoning and Machine Learning," 1st edition, Cambridge University Press, 2011
5. Bishop, C. M. "Pattern Recognition and Machine Learning (Information Science and Statistics)". 2nd printing, Springer, 2011
6. Wainwright, M. and Jordan, M. "Graphical Models, Exponential Families, and Variational Inference," Foundations and Trends in Machine Learning, 2008. Web Links:
7. Ankur Ankan, Abinash Panda Mastering Probabilistic Graphical Models with Python Packt Publishing

Web Links:

1. https://www.coursera.org/specializations/probabilistic-graphical-models?msockid=0fba0991cc8d64af281a1ae9cd3f657a
2. https://createmomo.github.io/2019/01/07/Probabilistic-Graphical-Models-Revision-Notes/

3. https://github.com/mcharrak/probabilistic-graphical-models-PGM-representation-coursera-daphne-koller

Online Resources
1. Probabilistic Graphical Models : https://girishvarma.in/teaching/prob-graph-models/
2. COL 776: Learning Probabilistic Graphical Models: COL 776: Learning Probabilistic Graphical Models

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Program: Artificial Intelligence (AI) and Data Science **Final Year B.Tech.** **Semester: VII**
Course: Blockchain Technology (DJS22ADC7013)
Course: Blockchain Technology Laboratory (DJS22ADL7013)

Prerequisite: Networking Fundamentals, Distributed Operating Systems

Course Objectives: The objectives of course are

1. To understand emerging Blockchain Technology and its relevance with cryptography
2. To demonstrate the use of cryptography required for Blockchain.
3. To understand smart contracts, wallets, and consensus protocols.
4. To design and develop Blockchain applications.

Course Outcomes: Students will be able to

1. Describe basic knowledge of Blockchain technology.
2. Explain methods for securing blockchain networks, including cryptography and consensus protocols.
3. Use various tools for Blockchain implementation.
4. Analyze the real-world applications of Blockchain technology.

Blockchain Technology (DJS22ADC7013)		
Unit No.	Description	Duration
1	**Introduction to Blockchain Technology** The Model of Decentralization, Distributed Systems for Decentralization, Blockchain framework, Characteristics of Blockchain, Block structure, Block header, Types of Blockchain: Public, Private and Hybrid Blockchain.	06
2	**Basic Crypto primitives** Cryptographic Primitives, Cryptographic Hash, Hash Functions, SHA-256, Puzzle Friendly, Secure Hash Algorithm, Hash Pointers, Merkle Tree, Hash Chain, Construction of Chain of Blocks, Public Key Cryptography, Digital Signature.	07
3	**Bitcoin and Consensus** The Evolution of Cryptocurrencies: Design Goals for Cryptocurrency Development **Introduction to Bitcoin:** Bitcoin block, bitcoin P2P network, Transactions, Bitcoin mining, double spending attack, Forks, The Monopoly Problem-51% attack **Consensus:** Consensus Approach, Consensus Algorithms: Proof-of-Stake (PoS), Proof-of-Work (PoW), Proof-of-Burn (PoB), Proof-of-Elapsed Time (PoET), State Machine Replication as a Consensus, Crash Fault Tolerance, PAXOS, Byzantine Fault Tolerant (BFT), BFT Consensus, Practical BFT.	10
4	**Ethereum** Ethereum and its Components, Ethereum Virtual Machine (EVM), Ethereum Ecosystem, Transaction, Comparison between Bitcoin and Ethereum, test- networks, Smart Contracts, Introduction to solidity programming, Ganache, MetaMask.	06
5	**Hyperledger** Introduction to Hyperledger Fabric, Key features of Hyperledger fabric, Hyperledger Fabric Architecture, Ethereum v/s Hyperledger framework, Fabric Test Network, Hyperledger Consensus, Fabric Transaction Flow, Hyperledger Tools and Libraries, Hyperledger Fabric Chaincode	06

6	**Blockchain Allied Technologies** Blockchain in DeFi: Case Study on any of the Blockchain Platforms, Blockchain in Healthcare, Blockchain and Artificial Intelligence, Blockchain for Trustworthy AI in Financial Services, Blockchain and IoT, Blockchain and Climate Change, Blockchain and RBI, Blockchain and GOI	04
	Total	**39**

List of Experiments:

1. To create basic Blockchain with sample transactions and print it
2. To implement Merkle root from the transactions and verify the validity of transactions using it.
3. To implement Proof of Work (PoW) concept in Bitcoin Mining and demonstrating it.
4. To analyse and implement Unspent Transaction Outputs (UTXOs) in Bitcoin and demonstrate the transactions using UTXOs.
5. To create and deploy Smart Contract using Solidity and Remix IDE.
6. To perform Embedding Wallet and transaction using Solidity and MetaMask.
7. To implement blockchain using Geth (Go-Ethereum).
8. To implement local Blockchain using tools viz. Ganache.
9. To interacting with the Ethereum Blockchain Using Web3.js
10. To install Hyperledger Fabric and demonstrate its usability.
11. To query and invoke transactions on Fabric Test Network

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

Books Recommended:

Textbooks:

1. Imran Bashir , Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing, 2020
2. Kumar Saurabh , Ashutosh Saxena, Blockchain Technology: Concepts and Applications , 1st Edition, Wiley Publication, 2020
3. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, -Blockchain Technology: Cryptocurrency and Applications, Oxford University Press, 2019
4. Cryptography and Network Security – Principles and Practice by William Stallings, Pearson 2017

Reference Books:

1. Antony Lewis, Basics of Bitcoins and Blockchain, Mango Publishing, 2021
2. Blockchain for Beginners, Yathish R and Tejaswini N, SPD,22 September 2019
3. Blockchain Basics, A non-Technical Introduction in 25 Steps, Daniel Drescher, Apress,1 January 2017
4. Blockchain with Hyperledger Fabric, Luc Desrosiers, Nitin Gaur, Salman A. Baset, Venkatraman Ramakrishna, Packt Publishing,18 November 2020
5. Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress,2018
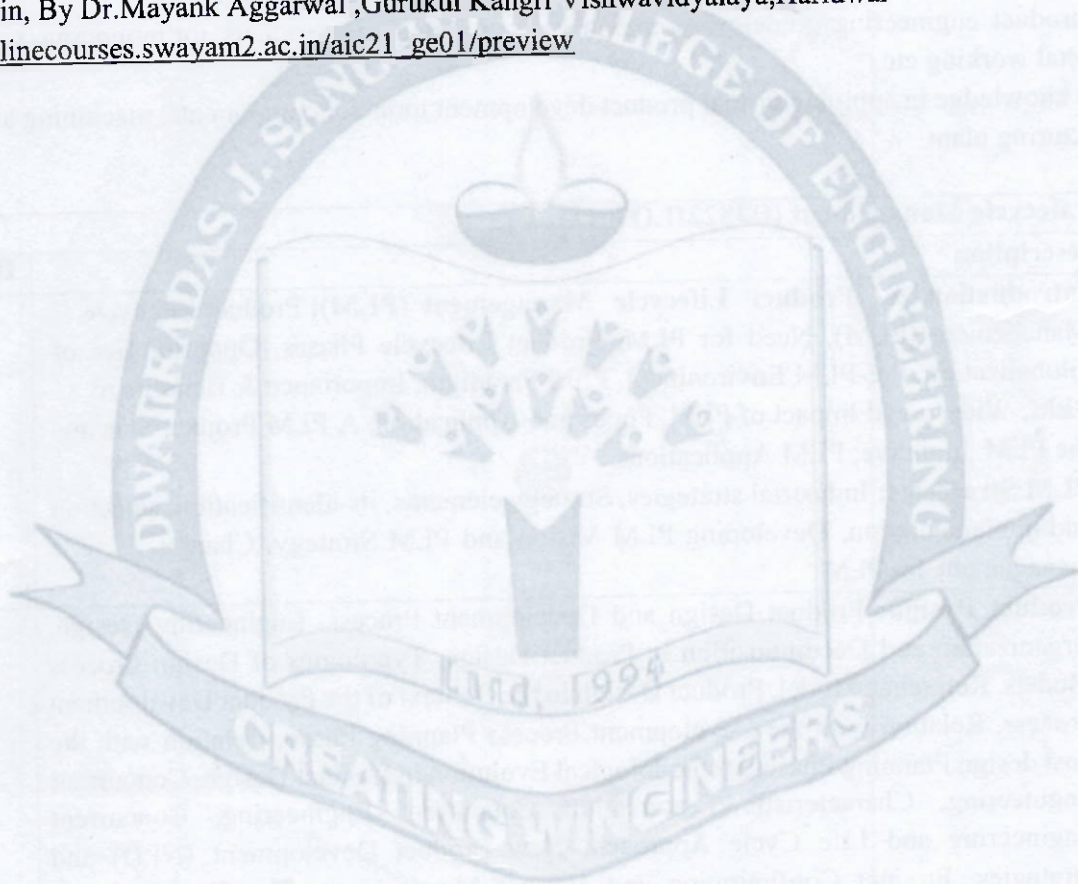
Web Links:

1. https://www.hyperledger.org/use/tutorials
2. https://ethereum.org/en/developers/
3. https://www.tutorialspoint.com/solidity/index.htm
4. https://docs.metamask.io/guide/

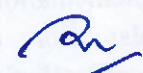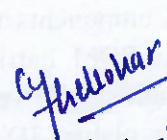## Online Resources:

1. Blockchain and its Applications, By Prof. Sandip Chakraborty, Prof. Shamik Sural IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc23_cs47/preview
2. Blockchain Architecture Design and Use Cases, By Prof. Sandip Chakraborty & Dr. Praveen Jayachandran |
   IIT Kharagpur and IBM, https://onlinecourses.nptel.ac.in/noc19_cs63/preview
3. Blockchain, By Dr.Mayank Aggarwal ,Gurukul Kangri Vishwavidyalaya,Haridwar
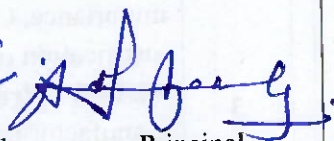   https://onlinecourses.swayam2.ac.in/aic21_ge01/preview

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Program: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech**   **Semester : VII**
Course: Product Lifecycle Management (DJS22ILO7011)

Prerequisite: Knowledge of basic concepts of Management.

Course Objectives: The objective of the course is

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. Describe 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 mounding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Product Lifecycle 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

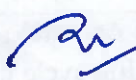## Books Recommended:

Textbooks:

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:

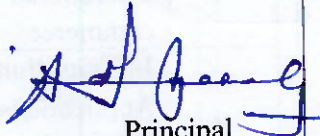1. Product Life Cycle Managementl, Saaksvuori Antti, Immonen Anselmie, Springer, Dreamtech
2. Product Lifecycle Management: Driving the next generation of lean thinking, Michael Grieve, TataMcGraw Hill, 2006
3. Product Life-Cycle Management: Geometric Variations, François Villeneuve, Luc Mathieu, MaxGiordano,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

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Program: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech**   **Semester : VII**

Course: Management Information System (DJS22ILO7012)

Course Objectives: The objective of the course is

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 needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Course Outcomes: The learner will be able t

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. Explain 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

Unit	Description	Duration
	Management Information System (DJS22ILO7012)	
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., RameshBehl
2. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
3. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing theDigital Firm, 10th Ed., Prentice Hall, 2007
4. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization,Prentice Hall, 2008

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Books Recommended:

Reference Books:

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

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Program: Artificial Intelligence (AI) and Data Science **Final Year B.Tech** **Semester : VII**
Course: Operations Research (DJS22ILO7013)

Prerequisites: Basic Knowledge of Algebra, Probability and Statistics.

Course Objectives: The objective of the course is

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, the learner will be able to:

1. Convert a real-world problem into a linear programming problem and analyse the solution obtained using the 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 the formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision-making in real life situations.
5. Explain the concept of decision-making in situations of competition and recommend strategies in the case of two-person zero-sum games.
6. Describe the simulation concept and apply Monte Carlo Simulation technique to systems such as inventory, and queuing and recommend solutions for them.
7. Explain need for the right replacement policy and determine optimal replacement age

Unit	Description	Duration
Operations Research (DJS22ILO7013)		
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**

Note: Educator is expected to introduce relevant software available for solving various mathematical models.

Books Recommended:

Textbooks:

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

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Program: Artificial Intelligence (AI) and Data Science   Final Year B.Tech   Semester : VII
Course: Cyber Security and Laws (DJS22ILO7014)

Course Objectives: The objective of the course is

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

Unit	Description	Duration
	Cyber Security and Laws (DJS22ILO7014)	
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 EquitiesKnowledge 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

	Security Industries Standard Compliances	
5	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 andAnalytics, 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 SciencePublishing
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: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech**   **Semester : VII**
Course: Personal Finance Management (DJS22ILO7015)

Prerequisites: Basic Knowledge of Algebra, Probability and Statistics

Course Objectives: The objective of the course is

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 familiarize 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. Explain how Microfinance can help in financial inclusion.

Unit	Description	Duration
	Personal Finance Management (DJS22ILO7015)	
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, SerialsPublication
2. Indian Banking Sector: Essays and Issues (1st) , by M.S. Gupta & J.B. Singh, SerialsPublication
3. Basics Of Banking & Finance , by K.M. Bhattacharya O.P. Agarwal , Himalaya PublishingHouse
4. Agricultural Finance And Management, by S. Subba Reddy , P. Raghu Ram .
5. The Indian Financial System And Development , by Dr.Vasant Desai, Himalaya PublishingHouse; 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 , EducreationPublishing
9. Introduction To Microfinance , By Todd A Watkins , World Scientific Publishing Company

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Program: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech**   **Semester : VII**

Course: Energy Audit and Management (DJS22ILO7016)

Course Objectives: The objective of the course is

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

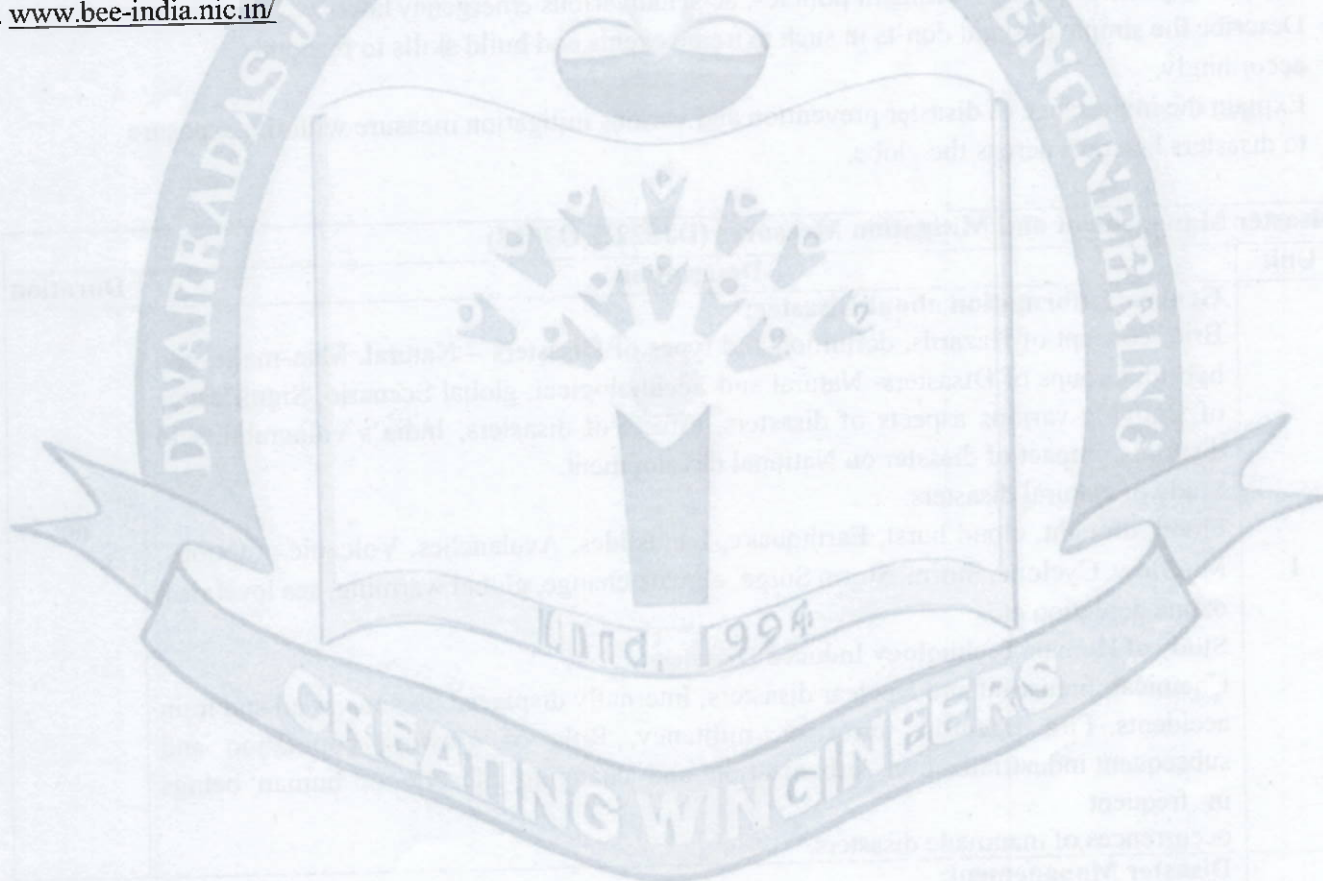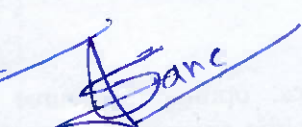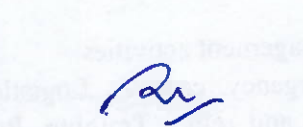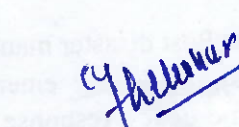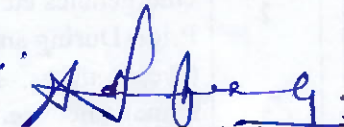| Unit	Description	Duration
	Energy Audit and Management (DJS22ILO7016)	
1	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, 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 drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
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/

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Program: Artificial Intelligence (AI) and Data Science   Final Year   B.Tech   Semester : VII
Course: Disaster Management and Mitigation Measures (DJS22ILO7017)

Course Objectives: The objective of the course is:

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

Unit	Description	Duration
Disaster Management and Mitigation Measures (DJS22ILO7017)		
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.
    (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

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Program: Artificial Intelligence (AI) and Data Science   **Final Year B.Tech**   **Semester : VII**
Course: Science of Well-being (DJS22ILO7018)

Course Objectives: The objective of the course is:

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: On completion of the course, learner will 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. Explain 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

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Program: Artificial Intelligence (AI) and Data Science   Final Year B.Tech   Semester : VII
Course: Research Methodology (DJS22ILO7019)

Prerequisites: Basic Knowledge of Probability and Statistics.

Course Objectives: The objective of the course is:

1. To understand the 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

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Program: Artificial Intelligence (AI) and Data Science   Final Year B.Tech   Semester : VII
Course: Public Systems and Policies (DJS22ILO7020)

Prerequisites: Basic Knowledge of Social science and Current affairs

Course Objectives: The objective of the course is:

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. Evaluate 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. Design 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.

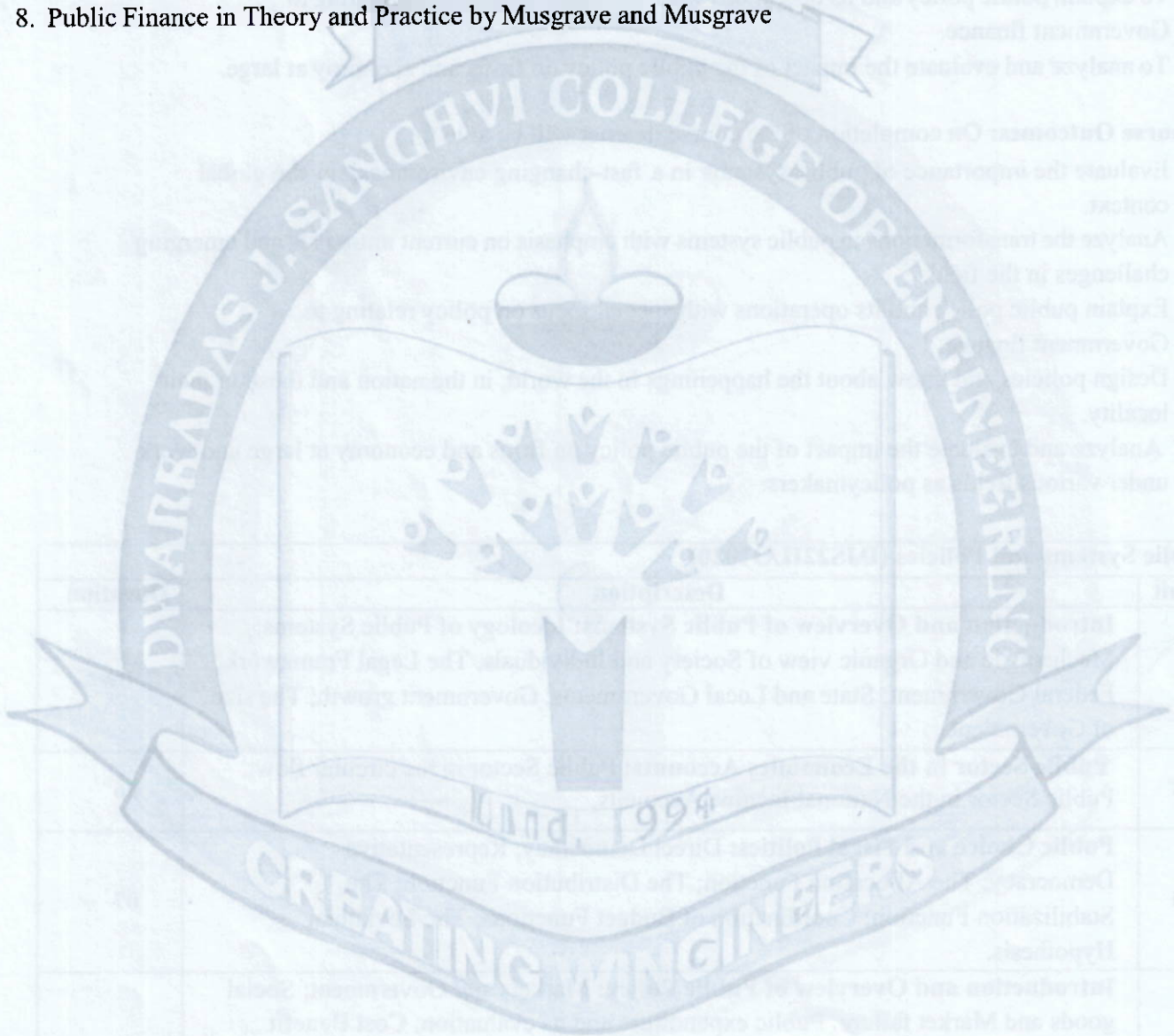| Public Systems and Policies (DJS22ILO7020)		
Unit	**Description**	**Duration**
1	**Introduction and Overview of Public Systems:** Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; 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

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Program: Artificial Intelligence (AI) and Data Science   **Final Year BTech**   **Semester : VII**

Course: Project Stage I (DJS22ADP704)

Course Objectives: The objective of the course is:

1. To introduce the students to professional engineering practice by providing them with an opportunity to work on an open-ended engineering problem.

2. To 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.

3. To apply not only their engineering knowledge and proficiencies (hard skills), but also to demonstrate their competence in generic, professional skills (soft skills).

4. Emphasizes the importance of life-long learning as a fundamental attribute of graduate engineers

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

1. Identify potential research areas in the field of Artificial Intelligence and Data Science design with Security.

2. Survey several available literature 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. Collaborate with team members of the team.

Guidelines:

1. Project Topic:

- To proceed with the project work it is very important to select a right topic. Project can be undertaken on any subject addressing the programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum three and must be original.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Student must consult internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decision regarding selection of projects.
- Student has to submit weekly progress report to the internal guide and whereas internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
- In case of industry projects, visit by internal guide will be preferred.

2. Project Report Format:

At the end of semester, a project report should preferably contain at least following details: -
Abstract
Introduction
Literature Survey
Survey Existing system
Limitation Existing system or research gap
Problem Statement and Objective
Scope
Proposed System
Analysis/Framework/ Algorithm
Details of Hardware & Software
Design details
Methodology (your approach to solve the problem)
Implementation Plan for next semester
Conclusion
References

Evaluation Scheme:

Continuous Assessment (A):

Laboratory: (Term work)

The distribution of marks for term work shall be as follows:
1. Weekly Attendance on Project Day
2. Project work contribute
3. Mid-Sem Review
4. Project Report
5. Term End Presentation

Review 1:
Selection and finalization of project topic.

Review 2:
1. Implementation Details & Status (50% project implementation)
2. Design & System Specifications
3. Presentation Quality
4. Contribution as a team member and Punctuality
5. Project Documentation.

Review 3:
1. Implementation Details & Status (80% project implementation)
2. Draft copy of research paper

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

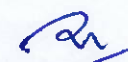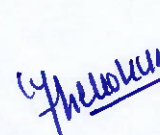**Semester End Examination (B):**

Laboratory:

- Oral and practical examination of Project Stage-I should be conducted by Internal and External examiners.
- Students have to give presentation and demonstration on the Project.
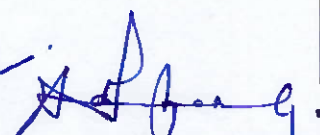
Prepared by   Checked by   Head of the Department   Vice Principal   Principal