Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus

Third Year B.Tech

in

Artificial Intelligence and Machine Learning

(Semester V)

Academic Year 2026-27

Proposed Scheme for Third Year Undergraduate Program in Artificial Intelligence and Machine Learning: Semester V (Autonomous)
Academic Year(2026-27)

	Sr. No.	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)						Aggregate (A+B)	Credits
				Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration	Theory	Oral	Pract	Oral & Pract	SEE Total(A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Term Test 3 (TT3)	Term Test Total (TT1 +TT2+ TT3)	Term work	CA Total (B)		
PC	1	DJS23APC301	Machine Learning	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	4
		DJS23APC301L	Machine Learning Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	
	2	DJS23APC302	Natural Language Processing	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	4
		DJS23APC302L	Natural Language Processing Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	
	3	DJS23APC303	Image Processing and Computer Vision	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	4
		DJS23APC303L	Image Processing and Computer Vision Laboratory	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	
PE	4@	DJS23APE301	Human Machine Interaction	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	4
		DJS23APE301L	Human Machine Interaction Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	
		DJS23APE302	Advanced Data Structures and Algorithms	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	
		DJS23APE302L	Advanced Data Structures and Algorithms Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	
		DJS23APE303	Recommendation Systems	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	
		DJS23APE303L	Recommendation Systems Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	
MD	5	DJS23AMD301	Computer Network	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3
	6	DJS23AMD302L	Programming Laboratory-III (Full Stack Development using NextJs)	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1
EL	7	DJS23XHS331T	Environmental Studies	--	--	1	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1
	8	DJS23XSC301P	Innovative Product Development III	--	2	--	1	2	--	--	--	25	25	--	--	--	--	25	25	50	1
SC	9	DJS23ASC301	App Development with AI and Flutter	1	--	--	1	--	--	--	--	--	--	15	15	10	40	--	40	40	1
Total				**16**	**12**	**1**	**23**	**22**	**300**	**75**	**--**	**75**	**450**	**90**	**90**	**60**	**240**	**175**	**415**	**865**	**23**

@ Department Elective

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

Continuous Assessment (A):

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

Continuous Assessment (B):

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

Prepared by Checked by HoD Vice Principal Principal

Program: Artificial Intelligence and Machine Learning	T.Y.BTech	Semester: V
Course: Machine Learning (DJS23APC301)		
Course: Machine Learning Laboratory (DJS23APC301L)		

Prerequisite: Knowledge of basic probability and statistics, Data Mining and Analytics concepts

Course Objectives:

1. To understand key machine learning concepts: hypothesis formation, biasvariance trade-off, and model evaluation metrics
2. To master regression, classification, and clustering techniques
3. To apply machine learning algorithms to real-world datasets effectively

Course Outcomes: By the end of the course, students should be able to:

1. Explain the types of machine learning and issues in machine learning
2. Analyze model performance using evaluation metrics.
3. Implement and tune regression and classification algorithms
4. Apply knowledge of Bayesian learning principles.
5. Apply association rule mining and clustering techniques.
6. Explain the fundamentals of Neural Networks.

Machine Learning (DJS23APC301)		
Unit	**Description**	**Duration**
1	**Introduction to Machine Learning:** Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps involved in developing a Machine Learning Application, Hypothesis and Inductive Bias, Bias-Variance Trade-off, Performance measures, Data Validation. Evaluation & Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves	6
2	**Regression**: Linear Regression, Least Minimum Slope (LMS) algorithm, Gradient Descent, Lasso and Ridge Regression. Polynomial Regression. Logistic Regression, Maximum Likelihood Function. Classification: Introduction to decision tree, Learning Decision tree using ID3 and Gini index; CART, Overfitting. Ensemble methods: Bagging (Random Forest) and Boosting (XG Boost)	8
3	**Bayesian Learning:** Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian, Belief Network, Inference in Bayesian Network, Applications of Bayesian Network. Classification Model	8

4	**Introduction to Support Vector Machine**: Support Vectors, Kernels: Linear, Polynomial and Radial Basis Function (RBF) Kernel Association Rule Mining: Market Basket Analysis, Apriori algorithm and measures of association.	6
5	**Clustering:** Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive. Dimensionality Reduction: Dimensionality Reduction Techniques: Principal Component Analysis	8
6	**Introduction to Neural Networks and Deep Learning**: Deep Learning applications, Association of biological neuron with artificial network, activation functions, weights, bias, threshold, learning rate, momentum factor **McCulloch Pitts Neuron**: Theory and architecture; linear separability; Hebb Network: Theory and algorithm, ANN architectures. Hyper-parameter tuning and batch normalization, Machine Learning vs Deep Learning.	6
	Total	42

Books Recommended:

Text books:

1. Mitchell, T. M., Machine Learning, McGraw Hill, 1st Edition, 2017
2. Ethem Alpaydın, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
3. Peter Harrington, 'Machine Learning In Action', DreamTech Press, 1st Edition, 2012.
4. Bruce, P., Bruce, A., & Gedeck, P., Practical statistics for data scientists: 50+ essential concepts using R and Python, O'Reilly Media, 2nd Edition, 2020

Reference Books:

1. Data Mining for Business Analytics, (An Indian Adaptation): Concepts, Techniques and Applications in Python, Cambridge University Press, ISBN NO. 978-1108727747, 2019.
2. Andreas C. Müller and Sarah Guido- Introduction to Machine Learning with Python: A Guide for Data Scientists, O'reilly,2016
3. Stephen Marsland, —Machine Learning an Algorithmic Perspective CRC Press, 2015
4. Han Kamber, —Data Mining Concepts & Techniques, Morgann Kaufmann Publishers, 2012.
5. Kevin P. Murphy, Machine Learning — A Probabilistic Perspective, 2012.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. https://www.datacamp.com/tutorial/tableau-tutorial-for-beginners
3. https://www.kaggle.com/code/ekami66/detailed-exploratory-data-analysis-with-python

NPTEL

1. Introduction to Machine Learning https://nptel.ac.in/courses/106106139

4	**Introduction to Support Vector Machine**: Support Vectors, Kernels: Linear, Polynomial and Radial Basis Function (RBF) Kernel Association Rule Mining: Market Basket Analysis, Apriori algorithm and measures of association.	6
5	**Clustering:** Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive. Dimensionality Reduction: Dimensionality Reduction Techniques: Principal Component Analysis	8
6	**Introduction to Neural Networks and Deep Learning**: Deep Learning applications, Association of biological neuron with artificial network, activation functions, weights, bias, threshold, learning rate, momentum factor **McCulloch Pitts Neuron**: Theory and architecture; linear separability; Hebb Network: Theory and algorithm, ANN architectures. Hyper-parameter tuning and batch normalization, Machine Learning vs Deep Learning.	6
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Reference Books:

1. Data Mining for Business Analytics, (An Indian Adaptation): Concepts, Techniques and Applications in Python, Cambridge University Press, ISBN NO. 978-1108727747, 2019.
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3. Stephen Marsland, —Machine Learning an Algorithmic Perspective CRC Press, 2015
4. Han Kamber, —Data Mining Concepts & Techniques, Morgann Kaufmann Publishers, 2012.
5. Kevin P. Murphy, Machine Learning — A Probabilistic Perspective, 2012.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. https://www.datacamp.com/tutorial/tableau-tutorial-for-beginners
3. https://www.kaggle.com/code/ekami66/detailed-exploratory-data-analysis-with-python

NPTEL

1. Introduction to Machine Learning https://nptel.ac.in/courses/106106139

2. Machine Learning for engineering and science applications https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs76
3. Mathematical foundation of machine learning https://onlinecourses.nptel.ac.in/elearning/preview/noc26_cs02
4. Machine Learning, ML https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs77

Coursera Course

1. Machine Learning Specialization — Andrew Ng
2. Machine Learning with Python by IBM
3. Mathematics for Machine Learning and Data Science

Machine Learning Laboratory (DJS23APC301L)	
Sr. No	**List of Suggested Experiments**
1	Study and Implementation of Machine Learning Workflow with Model Evaluation, Validation, and Selection Techniques 2
	To develop a Linear Regression model by performing data cleaning, exploratory data analysis, data transformation, model training, and performance evaluation.
3	To develop a Logistic Regression classification model by performing data preprocessing, exploratory data analysis, feature transformation, model training, and evaluation.
4	To develop a Decision Tree classification model using the Gini Index by performing data cleaning, exploratory data analysis, data transformation, model training, decision tree visualization, and performance evaluation.
5	To implement the CART (Classification and Regression Tree) Decision Tree algorithm by performing data cleaning, exploratory data analysis, data transformation, model training, decision tree visualization, and performance evaluation.
6	To implement Ensemble Learning methods by performing data cleaning, exploratory data analysis, data transformation, model training, and performance evaluation.
7	To implement a Bayesian Classification model by performing data cleaning, exploratory data analysis, data transformation, model training, and performance evaluation.
8	Implementation of Naïve Bayes Classifier and Bayesian Network for Classification
9	To compare the performance of different classification algorithms through model training and performance evaluation.
10	To implement a Support Vector Machine (SVM) model by performing data cleaning, exploratory data analysis, data transformation, and dimensionality reduction.
11	~~Perform clustering using K-Means and K-Medoids algorithms.~~
13	Implement an Artificial Neural Network (ANN) model for predictive analysis
14	Mini project based on any machine learning application

Minimum ten experiments from the above suggested list or any other experiment based on the syllabus

Prepared by Checked by HoD Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Natural Language Processing (DJS23APC302)		
Course: Natural Language Processing Laboratory (DJS23APC302L)		

Pre-requisite: Python Programming

Course Objectives:

1. To introduce the fundamental concepts and techniques of Natural Language Processing for analyzing words based on Morphology and CORPUS.

2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.

3. To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications.

Course Outcomes: Students will be able to

1. Understand the Principles and Process of Natural Languages and real-world applications.
2. Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.
3. Perform POS tagging for a given natural language and select a suitable language modelling technique based on the structure of the language.
4. Check the syntactic and semantic correctness of sentences using grammars and labelling.

Natural Language Processing (DJS23APC302)		
Unit	**Description**	**Duration**
1	**Introduction to Natural Language Processing** Origin & History of NLP, Stages in NLP, Ambiguities and its types in English and Indian Regional Languages; Applications of NLP- Machine Translation, Information Retrieval, Question Answering System, Sentiment Analysis, Text Categorization , Text Summarization, Named Entity Recognition.	5
2	**Word Level Analysis (statistical language model)** Inflectional Morphology, Derivational Morphology, Regular expression with types, Finite State Automata, NFA and DFA, Morphological Models: finite state morphology, Morphological parsing with FST (Finite State Transducer) , Grams and its variation: Bigram, Trigram, Simple (Unsmoothed) N-grams; N-gram Sensitivity to the Training Corpus, Evaluating N-grams: Perplexity, smoothing: Laplace Smoothing, Good-Turing Discounting	8
3	**Syntax analysis:** Part-Of-Speech tagging (POS): Tag set for English (Upenn Treebank), Difficulties/Challenges in POS tagging , Rule-based, Stochastic and Transformation-based tagging, Generative Model: Hidden Markov Model (HMM Viterbi) for POS tagging; Issues in HMM POS tagging, Discriminative	9

	Model: Maximum Entropy model, Conditional random Field (CRF), Syntax tree vs Parse tree, Parsers: Top down and Bottom up parsers, CYK.	
4	**Semantic Analysis:** Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babelnet. Attachment for fragment of English, Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy, Semantic Ambiguity, Word Sense Disambiguation (WSD), Knowledge based approach (Lesk's Algorithm), Supervised (Naïve Bayes, Decision List).	8
5	**Vectorsemantics And Embeddings** Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models, Word2vec. Distributed word representations, Word2Vec (CBOW, Skip-gram), GloVe and fastText. Multilingual embeddings with emphasis on Indian languages	8
6	**Pragmatic & Discourse Processing** Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence, Anaphora Resolution using Hobbs and Centering Algorithm, Discourse segmentation, Co-reference resolution	4
	TOTAL	42

Books Recommended:

Text Books:

1. Raymond S. T. Lee, "Natural Language Processing: A Textbook with Python Implementation", First Edition, 2023.
2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, "Natural Language Processing with Transformers", O'Reilly , 2022.
3. Thushan Ganegedara, Andrei Lopatenko, "Natural Language Processing with TensorFlow: The definitive NLP book to implement the most sought-after machine learning models and tasks", 2nd Edition, 2022.
4. Daniel Jurafsky, James H. and Martin, Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson, 2014.

Reference Books:

1. Masato Hagiwara, "Real-World Natural Language Processing: Practical applications with deep learning", Mnaning,2021.
2. Ashish Bansal, "Advanced Natural Language Processing with TensorFlow 2: Build effective real-world NLP applications using NER, RNNs, seq2seq models, Transformers, and more", Packt Publishing, 2021.

Web Resources Blogs and Websites:

1. POS Tagging Hidden Markov Models (HMM) Viterbi algorithm in NLP maths | Data Science in your pocket (medium.com)

2. Text Generation Using N-Gram Model | by Oleg Borisov | Towards Data Science
3. How to Create Beautiful Word Clouds in Python | by Tia Plagata | Towards Data Science
4. Best NLP Algorithms to get Document Similarity | by Jair Neto | Analytics Vidhya | Medium
5. How to Chunk Text Data — A Comparative Analysis | by Solano Todeschini | Towards Data Science
6. Natural Language Processing. Title :- Morphological Analysis | by Raghvendra Zarkar | Medium

Online Courses and Tutorials:

1. NPTEL Course : Natural Language Processing - Course (nptel.ac.in)
2. Cousera: Natural Language Processing Specialization [4 courses] (DeepLearning.AI) | Coursera
3. Udemy: NLP - Natural Language Processing with Python | Udemy

Suggested List of Experiments:

Natural Language Processing Laboratory (DJS23APC302L)	
Sr. No.	**Title of the Experiment**
1	Preprocessing steps in NLP: Tokenization, stop word Removal, Lemmatization, stemming using NLTK and SPACY
2	To perform NLP tasks on Indian Languages.
3	Perform morphological analysis and word generation for any given text
4	Implement Chunking for the given input text.
5	To evaluate N-grams and apply smoothing
6	To implement POS tagging using HMM.
7	CYK parsing (Cocke Younger-Kasami Parsing) or Chart Parsing
8	Implement Named Entity Recognition for any given text
9	a) Word Vector Representation (Bag of Words) b) Cosine Similarity Between Words/Documents c) TF-IDF Vectorization
10	Word Similarity using TF-IDF / PPMI
11	To train Word2Vec using CBOW.
12	Analysis of Discourse and Textual Coherence
13	Co-reference Resolution using Neural Models using spaCy / AllenNLP
14	Mini project

Minimum ten experiments from the above suggested list or any other experiment based on syllabus.

Prepared by Checked by HoD Principal

Program: Artificial Intelligence and Machine Learning	T.Y. B.Tech.	Semester: V
Course: Image Processing and Computer Vision (DJS23APC303)		
Course: Image Processing and Computer Vision Laboratory (DJS23APC303L)		

Prerequisite: - Basic Mathematics, Python Programming

Course Objectives:

1. To provide a fundamental understanding of image processing concepts, including image representation, enhancement techniques, and transformation methods
2. To equip students with the knowledge of image segmentation, morphological processing, feature detection, and motion analysis for practical applications in computer vision.
3. To introduce various image compression techniques and their significance in reducing storage and transmission costs while maintaining image quality

Course Outcomes:

1. Apply image enhancement in spatial domain
2. Analyse image in frequency domain through different transforms and enhancement in frequency domain
3. Apply different image segmentation, feature detection techniques on images
4. Examine and apply different morphological operations on an image
5. Apply geometric transformations on an image and Evaluate optical flow algorithms
6. Implement and evaluate image compression techniques

Image Processing and Computer Vision (DJS23APC303)		
Unit	**Description**	**Duration**
1.	**Image Processing Fundamentals and Image Enhancement:** Image types, Image formats, Sampling & Quantization. **Spatial Domain Techniques:** Point Processing; Digital Negative, Contrast Stretching, Thresholding, Bit Plane Slicing, Power Law Transformation, Dynamic Range Compression. Histogram Modelling; Histogram Stretching & Histogram Equalization. Neighbourhood Processing; Noise, Smoothing (Low Pass Averaging Filter, Low Pass Median Filter), Sharpening Filters (High Pass Filtering & High Boost Filtering). Mean filters, Order statistic filters	8
2.	**Image Segmentation:** Connectivity of Pixels, Detection of discontinuities (Point, Line, Edge), Detection of Edges (Computing Gradients, 1st order Derivative Filters,2nd order Derivative Filters, Laplacian of Gaussian). Region-based segmentation-Region Growing, Region Splitting, Region Merging, Region Split & Merge	8
3.	**Image Transforms & Morphological Processing:** Fourier Transform,1D-DFT, Frequency domain techniques - 2D-DFT, Low pass Filter (Ideal, Butterworth, Gaussian), High pass Filter (Ideal, Butterworth, Gaussian). Hadamard Transform, Walsh Transform. **Morphological Operations:** Dilation, Erosion, Opening, Closing	7

4.	**Geometric Transformations:** Translation, Rotation, Scaling, Shearing **Feature Detection & Description:** Interest or Corner Point Detectors- Harris and Hessian. Histogram of Oriented Gradients, Scale Invariant Feature Transform(SIFT), Speeded up Robust Features(SURF), Scale-Space Analysis- Image Pyramids	8
5.	**Object Segmentation & Detection:** Canny Edge Detection, Difference of Gaussian (DOG), Graph Technique, Distance Metrics, Global Thresholding, Otsu's Thresholding, Watershed Algorithm **Motion Analysis & Optical Flow:** Introduction to Motion Detection, Lucas-Kanade, Horn-Schunck	6
6.	**Image Compression:** Run-Length Encoding (RLE), Huffman Coding, LZW (Lempel-Ziv-Welch), Improved Grey Scale coding (IGS)	5
	TOTAL	42

Books Recommended:

Textbooks:

1. Rafael C. Gonzalez, *Digital Image Processing*, 4th Edition, 2018.
2. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, 1st Edition, 2006.
3. Richard Szeliski, *Computer Vision: Algorithms and Applications*, 2nd Edition, 2022.

Reference Books:

1. Emanuele Trucco and Alessandro Verri, *Introductory Techniques for 3-D Computer Vision*, 1st Edition, 1998.
2. William K. Pratt, *Digital Image Processing: PIKS Scientific Inside*, 4th Edition, 2007.
3. David Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, 2nd Edition, 2011.
4. E. R. Davies, *Computer and Machine Vision: Theory, Algorithms, Practicalities*, 4th Edition, 2012.
5. S. Jayaraman, S. Esakkirajan, and T. Veerakumar, *Digital Image Processing*, 2nd Edition, 2019.
6. Adrian Kaehler and Gary Bradski, *Learning OpenCV: Computer Vision with the OpenCV Library*, 1st Edition, 2008.

Web Links:

1. https://opencv.org/
2. https://staff.fnwi.uva.nl/r.vandenboomgaard/IPCV20162017/index.html
3. https://www.geeksforgeeks.org/computer-vision/
4. https://egyankosh.ac.in/handle/123456789/90205

Online Courses:

1. Computer Vision and Image Processing – Fundamentals and Applications
   - https://onlinecourses.nptel.ac.in/noc22_ee48/preview/

- https://www.coursera.org/learn/introduction-computer-vision-watson-opencv

2. Computer Vision
   - https://onlinecourses.nptel.ac.in/noc19_cs58/preview
   - https://www.coursera.org/specializations/computer-vision

3. Digital Image Processing
   - https://onlinecourses.nptel.ac.in/noc20_ee75/preview
   - https://www.coursera.org/learn/introduction-image-processing

Suggested List of Experiments

Image Processing and Computer Vision Laboratory (DJS23APC303L)	
Sr. No.	**Title of Experiment**
1	Point Processing Techniques (Digital Negative, Thresholding, Intensity Transformation, Contrast Stretching)
2	Sharpening & Smoothing filters
3	Histogram Modelling
4	Frequency Domain Filtering
5	Edge detection
6	Morphological Operations
7	Object Detection
8	Image assessment with NumPy and OpenCV
9	Image Transformation in OpenCV
10	Feature Detection using OpenCV- Corner
11	Image Arithmetic Operations
12	Image Compression
13	Motion analysis and Action detection
14	Project Based Learning
15	Research Article Review

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

Prepared by Checked by HoD Principal

Program: Artificial Intelligence & Machine Learning	TYB.Tech.	Semester: V
Course: Human Machine Interaction (DJS23APE301)		
Course: Human Machine Interaction (DJS23APE301L)		

Pre-requisite: Basic knowledge of computer systems, programming fundamentals, and software development concepts.

Objectives:

1. To introduce fundamental concepts of Human-Computer Interaction, including human factors, interaction models, and design principles.
2. To develop the ability to design user-centered and accessible interfaces using established design processes and methodologies.
3. To equip students with skills in prototyping, data collection, and usability evaluation for effective interface design.
4. To expose students to emerging trends in HCI such as AI, IoT, and smart interfaces, and their impact on user experience.

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

1. Explain fundamental concepts of Human-Computer Interaction and apply structured design processes, including design thinking, to develop user-centered solutions.
2. Construct effective user interfaces by applying principles of visual design, interaction styles, and cognitive aspects.
3. Perform data collection and analysis using appropriate qualitative and quantitative methods for user research.
4. Develop, test, and evaluate prototypes and interactive systems using usability principles, modern tools, and emerging technologies such as AI and IoT.

Human Machine Interaction (DJS23APE301)		
Unit	**Description**	**Duration**
1	**Introduction to HCI & Human Factors:** Introduction to HCI, History of UI Design, Human characteristics, I/O channels, Psychology of everyday actions, Reasoning & problem solving, Human vs Computer capabilities, HCI models & frameworks, Ergonomics, Interaction paradigms, Good vs Bad design, Accessibility basics, Digital transformation, Emerging trends (AI, AR/VR, Wearables), Real-world applications	7
2	**Design Process, Design Thinking & User-Centered Design:** Design principles, design mistakes, human considerations, interaction design process, usability engineering, prototyping basics, design rules (principles, standards, guidelines), Goal-directed design, Design Thinking (stages, frameworks, Double Diamond), User-centered design (UCD), personas, empathy mapping, mental models, affinity mapping, POV & HMW techniques, tools (Miro, Canva basics), inclusive & accessible design	8

3	**Interface Design & Cognitive Aspects:** GUI & Web UI concepts, Direct manipulation, Interface types (GUI, CLI, NUI, AR/VR), Interface metaphors, Conceptual models, Cognitive aspects (cognitive load, Miller's law, Gestalt laws, recognition vs recall), Distributed cognition, External cognition, Behavioural patterns, Interaction styles (menus, windows, controls), Case examples, Introduction to platforms like Behance.	7
4	**Data Collection, Prototyping & Evaluation:** Data requirements, data gathering (interviews, questionnaires, observation), qualitative & quantitative analysis, ethical considerations, prototyping (Lo-Fi, Mid-Fi, Hi-Fi), tools (Figma, Adobe XD), usability testing, evaluation techniques (heuristics, A/B testing, cognitive walkthrough), UX metrics, accessibility evaluation (WCAG), experimental design, data visualization best practices	8
5	**Advanced HCI: AI, IoT & Smart Interfaces:** Smart UI, AI-powered personalization, context-aware interfaces, IoT in HCI, HCI + AI integration, LLMs & multimodal systems, prompt engineering basics, conversational UI design, human-AI interaction, applications (healthcare, education), assistive technologies (Braille systems, ASD tools), AI tools (Canva AI, Firefly, Stable Diffusion), case studies, future trends	6
6	**Design Guidelines, Communication & UX Tools:** Design guidelines (Gestalt, perception, memory, color theory), communication (text, icons, multimedia, feedback), UI for web & mobile, case studies (mobile apps, assistive apps), UX tools (Figma, JustInMind, Penpot, MockFlow, Pencil), mobile ecosystem, application frameworks, types of mobile apps (native, hybrid, widgets)	6
	TOTAL	**42**

Books Recommended:

Textbooks:

1. When Machines Understand Us: The Human Side of Emotional AI, Taylor Royce, 2025.
2. Human-machine Interaction and Iot Applications for a Smarter World, Nishu Gupta (Editor), Srinivasa Kiran Gottapu, Rakesh Nayak, Anil Kumar Gupta, Mohammad Derawi, Jayden Khakurel, CRC, 2024.
3. Kalbande,Kanade,Iyer, "Galitz's Human Machine Interaction", 1st Edition, Wiley Publications, 2015.
4. Donald A. Normann," Design of everyday things", Basic Books; 2nd Edition, 2013

Reference Books:

1. Rogers Sharp Preece,IInteraction Design:Beyond Human Computer InteractionI,,Wiley, 2019.
2. Guy A. Boy —The Handbook of Human Machine InteractionI, Ashgate publishing Ltd. 2017.
3. Human-Computer Interaction: A Compact Reference for Practitioners, Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, Pearson College Div, 2003.

Online References:

1. NPTEL Course: https://onlinecourses.nptel.ac.in/noc25_cs38
2. https://www.coursera.org/learn/human-computer-interaction
3. https://www.edx.org/learn/human-computer-interaction
4. Human-Computer Interaction (HCI) Course for AI Systems Design

Suggested List of Laboratory Experiments:

Human Machine Interaction Laboratory (DJS23APE301L)	
Sr No	**Title of Experiment**
1	To analyze and compare good and bad user interface designs by identifying usability principles, design flaws, and user experience issues in real-world applications.
2	To study and evaluate a real-world system (e.g., ATM, mobile app, website) using HCI principles, interaction models, and usability criteria.
3	To examine ergonomic factors in human-computer interaction and assess their impact on user comfort, efficiency, and productivity.
4	To apply the stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test) to solve a real-world problem in a structured and user-centered manner.
5	To develop user personas and empathy maps to understand user needs, behaviors, motivations, and challenges in interface design.
6	To organize user research data using affinity mapping and formulate clear problem statements using POV and HMW techniques.
7	To design low-fidelity prototypes such as sketches and wireframes to represent initial interface ideas and user flows.
8	To create visually appealing user interface designs using Canva by applying layout, typography, and design principles.
9	To design interactive user interfaces using Figma, incorporating usability principles, consistency, and visual hierarchy.
10	To evaluate an interface based on cognitive principles such as memory load, perception, recognition vs recall, and user behavior patterns.
11	To collect user data using appropriate methods such as questionnaires and interviews for understanding user requirements.
12	To analyze collected data using qualitative and quantitative techniques and present insights through effective data visualization methods.
13	To develop interactive prototypes using tools like Figma or Adobe XD to simulate real-world user interfaces.
14	To evaluate user interfaces using usability testing methods such as heuristic evaluation, A/B testing, and cognitive walkthrough.
15	To design smart and adaptive user interfaces using AI-powered tools and techniques for personalization and automation.
16	To implement the complete HCI design lifecycle, including problem identification, user research, design, prototyping, evaluation, and presentation of an interactive system.
17	Mini Project: SDG 3: Good Health and Well-being Design a mobile application that provides accessible mental health resources (e.g., guided meditations, stress management techniques, links to support organizations) with a focus on user-centered design for diverse users, including those with disabilities or limited digital literacy. Interactive System for Promoting Healthy Habits

	SDG 4: Quality Education Accessible and Engaging E-Learning Platform for Underserved Communities: Design an e-learning platform with a focus on accessibility for learners in underserved communities, considering factors like low bandwidth, limited device capabilities, and varying levels of digital literacy. SDG 11: Sustainable Cities and Communities Mobile Application for Promoting Sustainable Transportation Choices: Design a mobile app that encourages users to adopt sustainable transportation options like walking, cycling, and public transport by providing real-time information, route planning, gamified challenges, and rewards.

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

Prepared by | Checked by | HoD | Principal

Program: Artificial Intelligence and Machine Learning	T.Y. B.Tech.	Semester: V
Course: Advanced Data Structures and Algorithm (DJS23APE302)		
Course: Advanced Data Structures and Algorithm Laboratory (DJS23APE302L)		

Pre-requisite: Python Programming, Data Structures, Design & Analysis of Algorithms

Course Objectives:

1. To provide conceptual and practical knowledge of Advance Data Structures and Algorithms.
2. To Cultivate algorithmic thinking and problem-solving skills through practice and exposure to diverse problem domains.
3. Develop strategies for breaking down complex problems into manageable sub problems and applying suitable algorithms and data structures.
4. Develop skills to analyze problem complexity and choose appropriate data structures and algorithms for efficient solutions.

Course Outcomes: Students will be able to

1. Understand the concept of time complexity and its importance in analyzing algorithms and to Explore the complexity analysis of popular machine learning algorithms.
2. Explore balanced search tree data structures and spatial data structures used in geometric and spatial applications.
3. Apply graph algorithms to solve real-world problems related to network flows, matching, and optimization.
4. Understand the complexity classes NP, P, NP-complete, and NP-hard and their significance in algorithm classification and to explore the computational geometry algorithms.

Advanced Data Structures and Algorithm (DJS23APE302)		
Unit	**Description**	**Duration**
1	**Analysis of Algorithm Based on Time:** i. **Amortized Analysis:** Aggregate Method, Accounting Method, Potential Method (for Stack data structure) ii. **Probabilistic and Randomized Algorithm:** Probabilisticapproach to algorithm and Randomized Analysis, Indicator Random Variable (IRV), Analysis of Hiring Problem **Complexity Analysis of Machine Learning Algorithms:** i. Training Time Complexity and Testing Time Complexity ii. Train/Test Complexity of Linear Regression iii. Train/Test Complexity of Naïve Bayes Classifier	08
2	**Balanced Search Trees:** Red-Black Tree, Tango Tree,2-3 Tree, B Tree, B+ Tree, Splay Tree, Skip list, Interval Tree	10
3	**Advanced Data Structures:**	08

	i. **Spatial Data Structure**: KD Tree, R Tree, Navigable Small world ii. **Probabilistic Data Structure**: Bloom filter, LogLog and HyperLogLog, Count Min sketch, MinHash with Machine Learning context (Vector Representation) iii. **Functional Data Structures**: Binomial Tree, Binomial Heap, Leftist Heap, Skew Heap	
4	**Graph Based Algorithms:** i. **Flow Network Introduction**: Residual Network, Augmenting Path, Ford-Fulkerson Method, Edmonds-Karp Method, Push-Relable Algorithm ii. **Bipartite Matching:** Maximum Bipartite Matching	07
5	**Classification of Algorithms:** i. **Algorithm Classes:** P, NP, NP Hardness and NP Completeness ii. **Np Completeness Proofs:** Satisfiability (3 sat), Reducibility, Cook's Theorem, Traveling Salesman Problem iii. **Approximation Algorithms:** Vertex Cover Problem, Travelling Salesman problem.	07
6	**Computational Algorithms – Computational Geometry:** Line Segment Properties, Convex Hull Graham's scan algorithm	02
	TOTAL	42

Books Recommended:

Text Books:

1. Introduction to Algorithms by Thomas H Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, Third Edition, 2009.
2. Design and analysis of algorithms by S. Sridhar Oxford First Edition, 2014
3. Horowitz, Sahani and Rajsekaran, —Fundamentals of Computer Algorithms, Galgotia, 2nd Edition,1998
4. Harsh Bhasin, Algorithms Design and Analysis, Oxford, 1st Edition, 2015.
5. Giuseppe Bonaccorso, Machine Learning Algorithms" by Packt, 2019

Reference Books:

1. Rajeev Motwani, Prabhakar Raghavan, Randomized Algorithm, Cambridge University, 2004
2. Vijay V. Vajirani, Approximation Algorithms, Springer, 2003
3. Computational Complexity, Stanford University, 2010
4. Jason Brownlee, "Master Machine Learning Algorithms", by Machine Learning Mastery, 2020

2. Vijay V. Vajirani, Approximation Algorithms, Springer, 2003
3. Computational Complexity, Stanford University, 2010
4. Jason Brownlee, "Master Machine Learning Algorithms", by Machine Learning Mastery, 2020

Web Resources Blogs and Websites:

1. Train/Test Complexity and Space Complexity of Linear Regression | by Writuparna Banerjee | Level Up Coding (gitconnected.com)
2. Computational Complexity of ML Models | by Paritosh Kumar | Analytics Vidhya | Medium
3. Importance of Understanding the Complexity of a Machine Learning Algorithm | by Baran Köseoğlu | Towards Data Science
4. Probabilistic Data Structures Decoded: Enhancing Performance in Modern Computing | by Naman Agrawal | Towards Data Science
5. ML Security Pro Tips: Understanding MinHash in a Security Context | by Melanie Beck | AI/ML at Symantec | Medium.
6. Bloom Filters and when to use them | by Janko Krstic | The Little Bit Ninja | Medium
7. The Power of Bloom Filters: A Comprehensive Guide | by Chiranjeet Baruah | Medium
8. Nptel : https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs158
9. IIT course: https://nsm.iitm.ac.in/cse/services/adv_dsa/
10. Coursera: https://www.coursera.org/specializations/data-structures-algorithms

Suggested List of Experiments: (Leetcode)

Advanced Data Structures and Algorithm Laboratory (DJS23APE302L)	
Sr. No.	**Title of the Experiment**
1	Experiment on Amortized Analysis.
2	To perform and implement Hiring Problem.
3	Experiment on Randomized Algorithms (Randomized Quick Sort)
4	To implement Red Black Tree
5	To implement Splay Tree
6	To implement Interval Tree
7	To implement Skip List
8	To implement Skew Heap
9	To implement Leftist Heap
10	To implement B+ Tree
11	To implement KD Tree
12	To implement Ford Fulkerson Algorithm
13	To implement Approximation Algorithms (Vertex Cover)
14	Experiment on Computational Geometry Algorithms (Graham Scan)

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

Prepared by Checked by HoD Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester:
Course: Recommendation Systems (DJS23APE303)		
Course: Recommendation Systems Laboratory (DJS23APE303L)		

Prerequisite: Knowledge of Machine Learning

Course Objectives:

1. To provide students with the basic concepts of Recommender Systems, design space, trade-offs and its application in various domain.
2. To have a broad understanding of the field of Recommendation Systems.

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

1. Understanding the architecture and working of Collaborative Filtering, Content based recommendation systems.
2. Understanding the architecture and basics of Knowledge based recommendation systems.
3. Analyzing hybrid and ensembles recommendation systems.
4. Evaluation of recommendation systems by selecting right evaluation paramcter.

Recommendation Systems (DJS23APE303)		
Unit	**Description**	**Duration**
1	**Introduction to Recommender Systems** Introduction to Recommendation System, Framework of recommendation systems, Eliciting Ratings and other Feedback Contributions, Implicit and Explicit Ratings, Recommender system functions. Applications of recommendation systems, Issues with recommender system. Data for recommendation: Explicit Vs Implicit data collection Scales of measurement, Machine learning foundations for recommender system, Data preprocessing	06
2	**Collaborative filtering-based Recommender System** Architecture of Collaborative Filtering, Collaborative filtering approaches: Memory based and model based, Memory based collaborative filtering foundations: Distance and similarity measures, User based collaborative filtering; Item based collaborative filtering. Model based collaborative filtering foundations: matrix factorization, UV decomposition, Singular value decomposition Model based collaborative filtering techniques: SVD.	08
3	**Content-based Recommender System:** Architecture of content-based systems, Content based recommender system foundations ,Examples with text data, Feature engineering: Feature extraction, feature selection, dimensionality reduction. Decision tree for Content recommendation, KNN for Content recommendation, Naïve based for Content recommendation.	07

4	**Knowledge based recommendation** Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders, Persistent Personalization in Knowledge-Based Systems, Conversational Recommendation. Search based recommendation, Navigation-based recommendation.	07
5	**Ensembled- Based and Hybrid Recommendation System** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta level, Limitations of hybridization strategies.	07
6	**Evaluating Recommendation System:** Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Online Recommender evaluation techniques. Comparison between evaluation design of classification model and recommendation system, Error metrics, Decision-Support metrics, User Centered metrics. Comparative analysis between different types of recommendation systems.	07
	TOTAL	42

Books Recommended:

Textbooks:

1. C.C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1 st Edition, 2016.
2. Sachi Nandan Mohanty, Jyotir Moy Chatterjee, Sarika Jain, Ahmed A. Elngar, Priya Gupta "Recommender System with Machine Learning and Artificial Intelligence" Oreilly Publication, 2020.
3. Jannach D., Zanker M. and FelFering A., "Recommender Systems: An Introduction",Cambridge University Press, 1st Edition, 2011.
4. Ricci, F., Rokach, L., & Shapira, B., Introduction to Recommender Systems Handbook. Springer, Boston, MA 2011.

Reference Books:

1. M.D. Ekstrand, J.T. Riedl, J.A. Konstan, "Collaborative filtering recommender systems", Now publishers, 1 st Edition, 2011.
2. J. Leskovec, A. Rajaraman and J. Ullman, "Mining of massive datasets", Cambridge,2 nd Edition, 2012.
3. Rounak Banik, "Hands-On Recommendation Systems with Python: Start building",Ingram short title, 2018.
4. P. Pavan Kumar, S. Vairachilai, Sirisha Potluri, "Recommender Systems: Algorithmsand Applications", CRC Press, 1st edition, 2021.
5. Kim Falk, "Practical Recommender Systems", Manning, 1st Edition, 2019
6. "Hands-On Recommendation Systems with Python: Start building powerful and personalized, recommendation engines with Python" by Rounak Banik , 2018.

Web Links:

1. NPTEL Recommender Systems: https://onlinecourses.nptel.ac.in/e-learning/course/noc26_ge24
2. Udemy course on Recommender Systems and Deep Learning inPython:https://realpython.com/build-recommendation-engine-collaborative- filtering.
3. Coursera course on Recommender Systems Specialization: https://www.coursera.org/specializations/recommender-systems
4. http://www.iem.iitkgp.ac.in/eco/Recommender_Systems/
5. https://www.coursera.org/specializations/recommender-systems
6. https://www.udemy.com/course/recommender-systems/
7. https://www.analyticsvidhya.com/blog/2021/08/developing-a-course-recommendersystem- using-python

List of Experiments:

Recommendation Systems Laboratory (DJS23APE303L)	
Sr. No.	**Title of the Experiment**
1	Build a Recommendation Engine with Item-Based Collaborative Filtering.
2	Build a Recommendation Engine with User-Based Collaborative Filtering.
3	Build Content-based recommendation engine on different datasets.
4	Build recommender system using association rule mining.
5	Implement Recommendation System using K-Nearest Neighbors
6	Build Context-Aware Recommender Systems.
7	Build Constraint-based Recommenders.
8	Implement knowledge-based recommender system.
9	Implement a Monolithic hybridization design
10	Evaluate the recommendation system with evaluation matrix.
11	Compare the performance of different recommender systems
12	Recommendation System Using Matrix Factorization • Implement SVD (Singular Value Decomposition).
13	Hybrid Recommendation System • Combine collaborative and content-based filtering.
14	Mini Project.

Batch wise laboratory work of minimum ten experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Prepared by Checked by HoD Principal

Program: Artificial Intelligence & Machine Learning	TY. BTech	Semester:V
Course: Computer Network(DJS23AMD301)		

Prerequisite: Statistics for Data Science, and Machine Learning – I.

Course Objectives:

1. To Master the principles of computer networking across all layers, from physical to application, including modern technologies like 5G.
2. Develop proficiency in network design, protocols, and problem-solving techniques for various networking scenarios.

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

1. Understanding the Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model & TCP/IP model.
2. Understand the fundamental concepts of the Data Link Layer and analyze different MAC protocols.
3. Design IP addressing schemes and implement routing solutions.
4. 4. Analyze various transport layer, application layer protocols.

Computer Network(DJS23AMD301)		
Unit	**Description**	**Duration**
1	**Introduction to Networking:** Introduction to computer network, network application, network software and hardware components, Network topology, design issues for the layers. Reference models: Layer details of OSI, TCP/IP models.	06
2	**Physical Layer:** Introduction to Digital Communication System: Guided Transmission Media: Twisted pair, Coaxial, Fiber optics. Unguided media: Bluetooth. Data Encoding techniques.	06
3	**Data Link Layer** DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction (Hamming Code, Parity, CRC, Checksum), Elementary Data Link protocols: Stop and Wait, Sliding Window (Go Back N, Selective Repeat), HDLC Medium Access Control Sublayer: Channel Allocation problem, Multiple Access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CA, CSMA/CD)	08
4	**Network Layer:** Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (Classfull and Classless),IPv4 Protocol, Network Address Translation (NAT), IPv6. **Routing algorithms**: Link state routing, Distance Vector Routing. **Routing Protocols** - ARP,RARP, ICMP, IGMP, RIP, OSPF **Congestion control algorithms:** Open loop congestion control, Closed loop congestion control, Token & Leaky bucket algorithms.	10
5	**Transport Layer:** The Transport Service, Port Addressing, Transport service primitives, Berkeley Sockets, Connection management (Handshake, Teardown), UDP, TCP, TCP Congestion Control: Slow Start	06

6	**Application Layer:** Hypertext Transfer Protocol (HTTP) , SMTP, POP3, IMAP (Internet Message Access Protocol) ,Telnet, File Transfer Protocol (FTP) , DHCP, Domain Name System (DNS).	**06**
	TOTAL	**42**

Books Recommended:

Textbooks:

1. C.C. 1. A.S. Tanenbaum, Computer Networks, 6th edition Pearson Education, 2020
2. 2B.A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, 6th edition, TMH, 2022
3. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, 6th edition, Pearson, 2017
4. David Hanes, Jerome Henry, Rob Barton, Gonzalo Salgueiro and Patrick Grossetete, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1/e, 2018

Reference Books:

1. M.D. Behrouz A. Forouzan, Firouz Mosharraf, Computer Networks: A Top-Down Approach, Mc Graw Hill, 2023
2. Dhanashree K. Toradmalle, Computer Networks and Network Design, Wiley, 2020.

Web Links:

1. Web resources:
    1. https://www.netacad.com/courses/networking/networking-essentials
    2. https://www.coursera.org/learn/computer-networking.
    3. https://www.edx.org/course/introduction-to-networking.
2. Online Courses: NPTEL / Swayam :
    1. https://nptel.ac.in/courses/106/105/106105081.
    2. https://nptel.ac.in/courses/106105183.
    3. https://onlinecourses.swayam2.ac.in/cec21_cs04/preview.

Prepared by Checked by HoD Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Programming Laboratory-III (Full Stack Development Using NextJs) (DJS23AMD302L)		

Pre-requisite: Basic knowledge of JavaScript, React.js, and fundamental database concepts

Course Objective:

1. Understand Next.js App Router architecture and its optimizations over the traditional Pages Router.
2. Learn to build full-stack web applications utilizing React Server Components (RSC) and type-safe data handling.
3. Implement Server Actions, Route Handlers, progressive streaming, and advanced caching paradigms.
4. Integrate production-ready, type-safe authentication and role-based access control using Better Auth.
5. Seamlessly connect relational (PostgreSQL/MySQL) and NoSQL databases via modern ORMs and ODM clients.
6. Apply performance configurations using Next.js core optimization components and metadata API.
7. Deploy modern full-stack production builds with Edge middleware, secure environment variables, and modern cloud hosting engines.

Course Outcomes (CO): On completion of the course, the students will be able to:

1. Explain Next.js App Router compilation, Server-vs-Client component trees, and hydration.
2. Formulate full-stack architectures utilizing Server Actions for data mutations and secure backend state tracking.
3. Execute secure authorization and multi-tenant session validation via Better Auth and Next.js Proxy/Middleware layers.
4. Deploy data-driven endpoints connecting relational platforms via Prisma ORM and object databases via Mongoose.

Programming Laboratory-III(Full Stack Development Using NextJs) (DJS23AMD302L)		
Unit	**Description**	**Duration**
1	**Introduction to Next.js & App Router Architecture** Scaffold projects using modern TypeScript configurations (create-next-app). Deep-dive into the app/ directory paradigm. File-system routing: page routes, layout inheritance, template files, nested route grouping (group), and dynamic segments [slug]. Compiling React Server Components (RSC) vs Client Components ('use client').	04
2	**Modern UI Engineering & Layout Orchestration** Integrating Tailwind CSS for utility-first responsive web design. Component-level isolated styling using CSS Modules. Architecting persistent state, global root layouts (layout.tsx), structural route-group layouts, and shared structural UI frames across partial rendering boundaries	05

3	**React Server Components, Server Actions & Streaming** Transition from legacy methods (getStaticProps, getServerSideProps) to asynchronous native fetch data fetching inside Server Components. Caching architectures: Request Memoization, Data Cache (use cache, revalidateTag), and Full Route Cache. Asynchronous UI rendering using loading.tsx and explicit React <Suspense> streaming boundaries. Implementing data mutations via Server Actions and building standard REST endpoints using App Router Route Handlers (route.ts).	05
4	**Database Integration (Prisma ORM & Mongoose)** Relational engineering: Establishing type-safe database schemas with PostgreSQL/MySQL utilizing Prisma ORM. Generating database clients and managing migrations. Performing advanced CRUD mutations inside Server Actions. Document stores: Connecting to MongoDB using Mongoose schema frameworks, creating collections, and processing document mutations securely.	05
5	**Modern Authentication, Session Control & Security** Setting up Better Auth with a database adapter backend. Configuring multi-provider OAuth (Google and GitHub sign-in flows) and secure Email/Password handling. Multi-tenant application protection: Session verification using Next.js Proxy layer (proxy.ts). Implementing role-based authorization rules (Admin, User, Guest) to restrict server route access.	05
6	**Optimization, Edge Layers & Cloud Deployment** SEO engineering: Implementation of static and dynamic SEO tracking via the Metadata API object. Asset optimizations using the next/image pipeline. Configuring modern cloud services (Vercel, Netlify). Setting up decoupled cloud databases (Supabase, PlanetScale). Managing secure deployment context via .env runtime configurations.	04
	TOTAL	28

Books Recommended:

Text Books:

1. Michele Riva, "Real-World Next.js: Build scalable, high-performance, and modern web applications using Next.js", Packt Publishing, 2022.
2. Kartik Bhat, "Ultimate Tailwind CSS Handbook: Build sleek and modern websites", 2023

Reference Books:

1. Larson, J. (2024). Full-Stack Web Development with Next.js: Modern techniques for building type-safe applications with App Router, Prisma, and TypeScript Packt Publishing Ltd.

Web Links:

1. Next.js Official Docs (App Router Specification): https://nextjs.org/docs
2. Better Auth Core Documentation: https://better-auth.com/docs
3. Prisma Object-Relational Mapping Reference: https://www.prisma.io/docs

NPTEL and Coursera Courses:

Course Code	Course Name	Institute / Instructor	Link
106105182	Software Engineering	IIT Kharagpur	https://nptel.ac.in/courses/106105182
Coursera	IBM Full Stack Software Developer Professional Certificate	IBM	https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer
Coursera	The Complete React 19 Developer Course (incl. Next.js 16) Specialization	Packt	https://www.coursera.org/specializations/packt-the-complete-react-19-developer-course-incl-next-js-16

Suggested List of Experiments:

Programming Laboratory-III (Full Stack Development Using NextJs) (DJS23AMD302L)	
Sr. No.	**Title of the Experiment**
1	Scaffold an App Router environment executing multi-page architectures with deep nested directories, specialized dynamic routes (`[id]`), and multi-layout route boundaries.
2	Construct a completely responsive dashboards or marketplace UI using modern Tailwind CSS configurations.
3	Build layout compositions using Next.js root layouts and localized sub-layouts to safely maintain state during client-side transitions.
4	Create standard API Route Handlers (`route.ts`) alongside native React Server Actions to manage data mutations (GET, POST, PUT, DELETE) without traditional API fetch boilerplates.
5	Establish a database layer using Prisma ORM with PostgreSQL/MySQL to wire relationship logic and handle full transactional operations.
6	Write operational schemas for an e-commerce catalog tracking system connecting Next.js with MongoDB through a Mongoose modeling structure.
7	Implement secure social authentication using Better Auth with Google and GitHub providers on a Next.js platform.
8	Build strict multi-role permission layers (Admin/User/Guest) by utilizing Next.js 16 `proxy.ts` middleware validation to block unauthorized server data access.
9	Optimize content performance scoring by writing dynamic SEO metadata objects and implementing asset-responsive `next/image` blocks.
10	Deploy an optimized application bundle live onto Vercel or Netlify, utilizing secure environment contexts mapping back to a remote Supabase or PlanetScale instance.
	Database Connection Pooling for Serverless Functions using Supabase or Neon.

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

Prepared by Checked by HoD Principal

Program: Artificial Intelligence and Machine Learning	TY.B.Tech.	Semester:V
Course: Environmental Studies (DJS23XHS301T)		

Prerequisite: -

1. Interest in Environment and its impact on Human Calculus.

Course Objectives: The objective of the course is:

1. Familiarise students with environment related issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Give overview of Green Technology options.

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

1. Understand how human activities affect environment.
2. Understand the various technology options that can make a difference.

Unit	Detailed Syllabus:	Duration
1	**Air Pollution** Sources of Air pollution. Definition of Air Quality Index and how it is measured.	1
2	**Water Pollution** Sources of water pollution. Ground water pollution and eutrophication.	1
3	**Noise Pollution** Noise pollution and sources. Decibel limits for hospital, library, silence zone.	1
4	**Biodiversity loss** Value of Biodiversity. Endangered species.	1
5	**Deforestation** Product and services provided by forests. Relationship between forests and climate change.	1
6	**Renewable Energy sources** Our energy needs and global energy crisis. Renewable energy sources.	1
7	**Climate change** Greenhouse gases and climate change.	1
8	**Green Technology** Data Center Energy Efficiency, Thin-Client and Energy Efficiency.	1
	Total	8

Books Recommended:

Text books:

1. Environmental Studies from Crisis to Cure, R. Rajagopalan, Oxford University Press, Second Edition,

2. Textbook of Environmental Studies for Undergraduate Courses, Erach Bharucha for University Grants Commission, New Delhi & Bharti Vidyapeeth Institute of Environment Education and Research.
3. Environmental Pollution: Principles, Analysis and Control; P. Narayanan, CBS Publishers
4. Green Information Technology: A Sustainable Approach, Mohammad Dastbaz, Colin Pattinson, Babak Akhgar, Morgan and Kaufman, Elsevier

Reference Books:

1. Information Technologies in Environmental Engineering: New Trends and Challenges, Paulina Golinska, Marek Fortsch, Jorge Marx-Gómez, Springer, 2011.

Websites:

1. CITES: www.cites.org
2. Convention on Biological Diversity: www.biodiv.org
3. Kalpvriksh: www.kalpvriksh.org
4. Water pollution: http://en.wikipedia.org/wiki/Water_polution
5. Ecosan: www.eco-solutions.org

List of Tutorials

SN.	Tutorial List
1	Case study on Smog.
2	Presentation on Water Pollution (Industrial, Sewage) explaining any specific case.
3	List effects of noise pollution on human health. Measure decibel level in college library, canteen, classroom
4	Case study on effect of pollution on Biodiversity loss.
5	Debate for and against to promote Economic Growth Deforestation is required.
6	Presentation on different Renewable Energy Technologies.
7	Report on major impact of Global warming on Environment giving real examples.
8	Report on advantages and examples of Green Building for Sustainable development, Sustainable Software Design.

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

Prepared by Checked by HoD Principal

Program: Artificial Intelligence & Machine Learning	T.Y.BTech	Semester: V
Course: Innovative Product Development III (DJS23XSC301P)		

Objectives:

1. To equip students with the process of designing and developing a software/ hardware solution for a selected problem while collaborating as a team.
2. To familiarize students with the process of applying fundamental engineering principles in order to design and develop a successful value-added solution.
3. To impart the core concepts of entrepreneurship, self-learning and research processes essential for conceptualizing a successful software/ hardware solution.

Outcome: Learner will be able to:

1. Apply standard engineering principles and practices to overcome the gaps in existing systems/research by conceptualizing a software/ hardware solution.
2. Demonstrate working of the system with proficiency in written and oral communication.
3. Develop interpersonal skills, while working as a team.

Guidelines for the proposed product design and development:

1. Students in the team shall understand the effective need for problem solving and accordingly select the best possible design in consultation with the faculty supervisor.
2. Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
3. The faculty supervisor may offer guidance to students throughout the activity, spanning four semesters, stated from semester III, with a primary emphasis on self-learning.
4. A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
5. The design solution should be validated with appropriate justification, and the report must be prepared in a standardized format for submission.
6. The focus should be on self-learning, the ability to design and innovate new product, and developing solutions to societal problems. The two year-long courses should also enhance entrepreneurial skills and overall quality development, ensuring the creation of a product of appropriate standards.

Guidelines for Assessment of the work:

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

3. The departments should prepare appropriate rubrics based on the learning outcomes.
4. Distribution of marks individually for the both reviews during the semester shall be as given below:
    a. Marks awarded by the review committee based on rubrics for Review -I : 25
    b. Marks awarded by the review committee based on rubrics for Review -II : 25
5. Average of both the reviews should be counted as Term-work.

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

In Semester V, students should have their design or prototype, including the selection of components/systems/Methodology. Two reviews will be conducted based on the presentations made by the student teams:

- The first review will focus on evaluating the partial Design/Prototype/Working model justifying the gap resolution.
- The second review will focus on assessing the finalized design or working model to ensure it meets the required specifications. More weightage should be given to novelty in the design.

The overall work done by the team will be assessed based on the following criteria:

1. Quality of survey or need identification for the product/work.
2. Clarity in problem definition (design and development) based on identified gaps.
3. Innovativeness of the proposed design or solution.
4. Feasibility of the proposed design and the selection of the best solution.
5. Cost-effectiveness of the product.
6. Societal impact of the product.
7. Functionality of the working model/prototype/design, meeting the stated requirements.
8. Effective application of standard engineering norms and practices.
9. Contribution of each team member or the team leader.
10. Clarity in the write-up and presentation.

The semester V reviews may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

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

The product's design and development will be evaluated through a presentation and demonstration of the working model by the student team to a panel of internal and external examiners. Preferably, the external examiners will be industry professionals or researchers with over five years of experience, approved by the Head of the Institution.

Prepared by | Checked by | HoD | Principal

Program: Artificial Intelligence and Machine Learning	T.Y.BTech	Semester: V
Course: App Development with AI and Flutter (DJS23ASC301)		

Pre-requisites:

Web development, OOP concepts.

Course Objectives:

1. To integrate AI-driven assistants (like Google Gemini) into the software development lifecycle to accelerate coding, debugging, and app optimization.
2. To introduce the foundational concepts of the Dart programming language and Object-Oriented Programming principles.
3. To familiarize learners with the Flutter framework and its toolchain for building cross-platform mobile applications.
4. To develop skills in designing interactive user interfaces using Flutter widgets, state management, and routing.
5. To provide hands-on experience in building, testing, and deploying a functional, multi-page application that consumes external APIs.

Course Outcomes:

1. Integrate AI tools, such as Gemini, into the application development workflow to assist with code generation, debugging, and optimization.
2. Configure the Flutter development environment and apply core Object-Oriented Programming principles using the Dart programming language.
3. Design and implement interactive, cross-platform user interfaces utilizing fundamental Flutter widgets, navigation, and routing.
4. Build and structure a complete, multi-page mobile application capable of fetching and processing data from external web APIs.

App Development with AI and Flutter (DJS23ASC301)		
Unit	**Description**	**Duration**
1	**Gemini for Application Developers** Develop an app with Gemini assistance, Introducing Gemini for application developers, Mini Project I: an application built based on the concepts learned.	4
2	**Introduction to Flutter and Dart** Introduction to Flutter, Flutter Development Environment, Comparison of Flutter with Other Mobile Frameworks, Flutter Toolchain, SDK, and Tools, Introduction to Flutter Utilities, Basics of Dart	3
3	**Exploring Dart Language** Internals of Dart, The Fundamentals of Dart, Variables and Types, Functions and Methods in Dart, Classes in Dart, Libraries in Dart, Command Line and Utilities,	3
4	**Working with Flutter** Development Process of Flutter Apps, Widgets, Interaction and Forms, Navigation, Routing, Implementing Styles.	5

5	**Building a Flutter Application** Mini Project II: Build a multi-page app that fetches web API data. Utilize the common flutter widgets for layouts, images and other media.	5
	Total	**20**

Online Course:

1. Gemini for Application Developers - https://www.coursera.org/learn/gemini-for-application-developers
2. Flutter and Dart: Developing iOS, Android, and Mobile Apps - https://www.coursera.org/learn/flutter-and-dart-developing-ios-android-mobile-apps

Useful Courses:

1. Flutter & Dart Complete App Development Course Specialization - https://www.coursera.org/specializations/packt-flutter-dart-complete-app-development-course
2. Apply Flutter App Development From Beginner to Advanced Specialization - https://www.coursera.org/specializations/google-flutter-app-development-beginner-advanced

Prepared by Checked by HoD Principal