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 2025-26

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

Proposed Scheme for Third Year Undergraduate Program in Artificial Intelligence and Machine Learning: Semester V (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	Assg/CP/GD/ Presentation/ Quiz) - c	Total (a+b+c)	Term work	CA Total	Duration	Theory	Oral	Pract	Oral & Pract	SEE Total		
PCC	1	DJS23ACPC501	Machine Learning	3	--	--	15	15	10	40	--	40	2	60	--	--	--	60	100	3
		DJS23ALPC501	Machine Learning Laboratory	--	2	--	--	--	--	--	25	25	2	--	25	--	--	25	50	1
	2	DJS23ACPC502	Natural Language Processing	3	--	--	15	15	10	40	--	40	2	60	--	--	--	60	100	3
		DJS23ALPC502	Natural Language Processing Laboratory	--	2	--	--	--	--	--	25	25	2	--	25	--	--	25	50	1
	3	DJS23ACPC503	Image Processing and Computer Vision	3	--	--	15	15	10	40	--	40	2	60	--	--	--	60	100	3
		DJS23ALPC503	Image Processing and Computer Vision Laboratory	--	2	--	--	--	--	--	25	25	2	--	--	--	25	25	50	1
MD	4	DJS23ACMD504	Computer Network	3	--	--	15	15	10	40	--	40	2	60	--	--	--	60	100	3
	5	DJS23ALMD505	Programming Laboratory-III(Full Stack Development using NextJs)	--	2	--	--	--	--	--	25	25	2	--	--	--	25	25	50	1
PE	6	DJS23ACPE511	Human Machine Interaction	3	--	--	15	15	10	40	--	40	2	60	--	--	--	60	100	3
		DJS23ALPE511	Human Machine Interaction Laboratory	--	2	--	--	--	--	--	25	25	2	--	25	--	--	25	50	1
		DJS23ACPE512	Advanced Data Structures and Algorithms	3	--	--	15	15	10	40		40	2	60	--	--	--	60	100	3
		DJS23ALPE512	Advanced Data Structures and Algorithms Laboratory	--	2	--	--	--	--	--	25	35	2	--	25	--	--	25	50	1
		DJS23ACPE513	Recommendation Systems	3	--	--	15	15	10	40		40	2	60	--	--	--	60	100	3
		DJS23ALPE513	Recommendation Systems Laboratory	--	2	--	--	--	--	--	25	25	2	--	25	--	--	25	50	1
Common Courses	7	DJS23ITHSX10	Environmental Studies	--	--	1	--	--	--	--	25	25	--	--	--	--	--	--	25	1
	8	DJS23IPSCX03	Innovative Product Development III	--	2	--	--	--	--	--	25	25	2	--		--	25	25	50	1
	Total			**15**	**12**	**1**	**75**	**75**	**50**	**200**	**175**	**375**	**22**	**300**	**75**	**0**	**75**	**450**	**825**	**22**

Prepared by: Name and Signatures (with date)	Head of Department Dr. Aruna Gawde	Vice-Principal Dr. Narendra Shekokar	Principal Dr. Hari Vasudevan
Checked By Name and Signatures (with date)			

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 & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Machine Learning (DJS23ACPC501)		
Course: Machine Learning Laboratory (DJS23ALPC501)		

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 (DJS23ACPC501)		
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	5
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.	5
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.	5
Total		39

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

Machine Learning Laboratory (DJS23ALPC501)	
Sr. No	**List of Suggested Experiments**
1	Perform Linear Regression. a. Perform data cleaning b. EDA c. Data transformation d. Model Training e. Performance evaluation
2	Perform Logistic Regression. a. Perform data cleaning b. EDA c. Data transformation d. Model Training e. Performance evaluation
3	Perform Decision Tree using GINI. a. Data cleaning b. EDA c. Data transformation d. Model Training, Visualize Decision Tree e. Performance evaluation
4	Perform CART decision tree algorithm. a. Data cleaning b. EDA c. Data transformation d. Model Training, Visualize Decision Tree e. Performance evaluation
5	Perform Ensemble methods a. Data cleaning b. EDA c. Data transformation d. Model Training e. Performance evaluation
6	Perform Bayesian Classification a. Data cleaning b. EDA c. Data transformation d. Model Training e. Performance evaluation
7	Compare performance of classification algorithms. a. Model Training b. Performance evaluation c. Comparison of performance of different classification algorithms
8	Perform Support Vector Machine. a. Data cleaning b. EDA c. Data transformation d. Dimensionality reduction

9	Perform K-means/ K-Medoids clustering. a. Data cleaning b. EDA c. Data transformation d. Clustering
10	Study a machine learning patent.
11	Mini project based on any machine learning application.

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

Prepared by Checked by HoD Vice Principal Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Natural Language Processing (DJS23ACPC502)		
Course: Natural Language Processing Laboratory (DJS23ALPC502)		

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 (DJS23ACPC502)		
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.	4
2	**Computational tools for text analysis** Basic Terms: Tokenization, Tokenization in the NLTK, Tokenizing text, Stemming, Lexicon free FST Porter Stemmer algorithm, Lemmatization, Natural Language Toolkit (NLTK): Corpora and other data resources. Uses of corpora: Lexicography, Grammar and syntax, Stylistics, Training and evaluation. Basic corpus analysis: Frequency distribution building and analyzing a corpus.	4
3	**Word Level Analysis (statistical language model)** Inflectional Morphology, Derivational Morphology, Regular expression with types, Finite State Automata, NFA and DFA, Morphological Models: finite state	9

	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	
4	**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 Model: Maximum Entropy model, Conditional random Field (CRF), Syntax tree vs Parse tree, Parsers: Top down and Bottom up parsers, CYK.	9
5	**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
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	5
	TOTAL	39

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 (DJS23ALPC502)	
Sr. No.	**Title of the Experiment**
1	Preprocessing steps in NLP: Tokenization, stop word Removal, Lemmatization, stemming using NLTK and SPACY
2	Implement Named Entity Recognition for any given text
3	Perform morphological analysis and word generation for any given text
4	Implement Chunking for the given input text.
5	Build a POS tagger using HMM
6	Similarity Detection in NLP
7	Implement N-Gram model for the given text input
8	Generate word cloud using Python
9	Any application of NLP: Spell Check, Autocorrect, plagiarism detection, sentiment analysis, sarcasm detection or text analytics in any domain

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

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Image Processing and Computer Vision (DJS23ACPC503)		
Course: Image Processing and Computer Vision Laboratory (DJS23ALPC503)		

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:

On completion of the course, learner will be able to

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 (DJS23ACPC503))		
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).	**8**

	Region-based segmentation-Region Growing, Region Splitting, Region Merging, Region Split & Merge	
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	**5**
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	**39**

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 (DJS23ALPC503)	
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 eight 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

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Computer Network (DJS23ACMD504)		

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 (DJS23ACMD504)		
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.	**05**
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** DNS: Name Space, Resource Record and Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP	**04**
	TOTAL	**39**

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.

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Programming Laboratory-III (Full Stack Development Using NextJs) (DJS23ALMD505)		

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

Course Objective:

1. Understand the fundamentals of Next.js and its advantages over traditional React applications.
2. Learn how to build full-stack applications using Next.js and integrate various databases.
3. Implement server-side rendering (SSR), static site generation (SSG), and API routes in Next.js.
4. Explore authentication, authorization, and state management techniques.
5. Deploy Next.js applications on cloud platforms like Vercel, Netlify, or AWS.
6. Optimize web applications for performance and SEO.
7. Work with relational (MySQL, PostgreSQL) and NoSQL (MongoDB, Firebase) databases for dynamic data handling.

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

1. Demonstrate an understanding of Next.js architecture and its role in modern web development.
2. Develop full-stack applications integrating databases and API routes.
3. Implement authentication and authorization techniques for secure web applications.
4. Apply relational (MySQL, PostgreSQL) and NoSQL (MongoDB, Firebase) databases for dynamic data handling

Programming Laboratory-III(Full Stack Development Using NextJs) (DJS23ALMD505)		
Unit	**Description**	**Duration**
1	**Introduction to Next.js** Install Next.js and configure a basic project. Explore the file structure of a Next.js project. Develop a multi-page application using the Next.js routing system. Implement dynamic and nested routes.	**03**
2	**Styling and UI Design** Use CSS Modules for component-level styling. Integrate Tailwind CSS for responsive design. Create a global layout component for consistent UI across pages.	**05**
3	**Data Fetching and API Routes** Implement getStaticProps, getServerSideProps, and getStaticPaths. Compare SSR, SSG, and CSR. Create API routes in the pages/api/ directory. Implement GET, POST, PUT, and DELETE requests.	**05**

4	**Database Integration** Set up a MySQL or PostgreSQL database using Prisma ORM. Perform CRUD operations. Connect to MongoDB using Mongoose. Perform CRUD operations on a products collection.	**05**
5	**Authentication and Authorization** Implement Google and GitHub authentication using NextAuth.js. Manage user sessions securely. Implement different user roles (Admin, User, Guest). Restrict access to certain pages based on roles.	**05**
6	**Performance Optimization and SEO and Deployment and Cloud Services** Implement metadata using next/head. Optimize images using next/image. Deploy a Next.js project on Vercel and Netlify. Set up environment variables for security. Use Supabase or PlanetScale for database integration. Compare performance with traditional databases.	**03**
TOTAL		**26**

Books Recommended:

Text Books:

1. Gianni Ciolli, Boriss Mejías, Jimmy Angelakos, Vibhor Kumar, Simon Riggs, "PostgreSQL 16 Administration Cookbook", 2023.
2. Luca Ferrari, Enrico Pirozzi, "Learn PostgreSQL: Use, Manage, and Build Secure and Scalable Databases with PostgreSQL 16", Packt Publishing Ltd, 2023.
3. Roberto Rescigno, "Tailwind CSS: A Guide to Using the Popular Utility-first CSS framework", 2023.
4. Fritz Schneider and Thomas Powell, "JavaScript: The Complete Reference", 2012.

Reference Books:

1. Michele Riva, "Real-World Next.js: Build scalable, high-performance, and modern web applications using Next.js, the React framework for production", 2022.
2. Kartik Bhat, "Ultimate Tailwind CSS Handbook: Build sleek and modern websites with immersive UIs using Tailwind CSS", 2023.
3. Noel Rappin, "Modern CSS with Tailwind: Flexible Styling Without the Fuss", 2021.

Web Links:

1. https://nextjs.org/docs
2. https://www.coursera.org/learn/introduction-to-mongodb
3. https://www.coursera.org/learn/learn-tailwind-css?
4. https://www.coursera.org/learn/introduction-to-next-js

Suggested List of Experiments:

Programming Laboratory-III (Full Stack Development Using NextJs) (DJS23ALMD505)	
Sr. No.	**Title of the Experiment**
1	Develop a Multi-Page Application with Dynamic and Nested Routes in Next.js

2	Develop a Responsive Web Design with Tailwind CSS in Next.js
3	Build a Reusable Layout Component for Consistent UI
4	Implement API Routes in Next.js: Building CRUD Operations with GET, POST, PUT, and DELETE Requests
5	Set up a database, integrate Prisma ORM, and performing CRUD operations using Prisma.
6	Connect to MongoDB with Mongoose and Perform CRUD Operations on a Products Collection in Next.js
7	Implement Google and GitHub Authentication with NextAuth.js
8	Implement user roles (Admin, User, Guest), restricting access to pages based on roles, and managing secure user sessions.
9	Optimize the Performance and SEO in Next.js using next/head and next/image for Metadata and Image Optimization
10	Deploy a Next.js Application on Vercel and Netlify: Environment Variables and Database Integration with Supabase/PlanetScale
11	Mini Project

Minimum eight 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

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Human Machine Interaction (DJS23ACPE511)		
Course: Human Machine Interaction (DJS23ALPE511)		

Pre-requisite: --

Objectives:

1. This course provides an opportunity to learn and apply the design principles of Human Machine Interaction.
2. Learners will learn the basic human psychology of everyday actions and will be able to design an UI prototype of an application.
3. This course covers the discussion on various interaction design concepts.
4. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for interface design using various UX tools.

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

1. Understand Foundational Concepts of Human-Machine Interaction
2. Illustrate User-Centered Design Principles and Processes
3. Analyze and Design Effective User Interfaces.
4. Discover the various UX prototyping tools and its applications.

Human Machine Interaction (DJS23ACPE511)		
Unit	**Description**	**Duration**
1	**Introduction:** The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving. The computer: Devices, Memory, processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms	**6**
2	**Design & Software Process:** Mistakes performed while designing a computer system, Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds. Interactive Design basics, process, scenarios, navigation, Iteration and prototyping. HMI in software process: software life cycle, usability engineering, Prototyping in practice, design rationale. Design rules: principles, standards, guidelines, rules. Recognize the goals, Goal directed design process. Evaluation Techniques: Universal Design.	**8**
3	**Graphical User Interface and Web Interface:** The Graphical User Interface: Popularity of graphics, the concept of direct manipulation, characteristics of GUI, Web user Interface: Interface	**7**

	popularity, characteristics. The merging of graphical Business systems and the Web. Principles of user interface design.	
4	**Design Guidelines & Interaction Styles:** Perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, and time. Interaction Styles: Menus, Windows, Device-based and Screen- based Controls. Communication: Text messages, Feedback, and Guidance, Icons, Multimedia, and colors.	**7**
5	**Communication**: Text Messages, Feedback and Guidance, Icons, Multimedia, Color and Human Vision, Colors for Textual Graphics, Stastical Graphics Screen, and Web pages. Case Study-Voice enabled Android Application for Vehicular Complaint System, Applying Human Computer Interaction to individual security using mobile application, Machine learning Applied to Human Learning, Educative Games for Autistic Children.	**6**
6	**UX tools:** Figma, Just In Mind, and any open-source tool for prototype designing like Penpot, MockFlow, Pencil Project. Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.	**5**
	TOTAL	**39**

Books Recommended:

Textbooks:

1. When Machines Understand Us: The Human Side of Emotional AI, Taylor Royce, 2025.
2. Kalbande,Kanade,Iyer, "Galitz's Human Machine Interaction", 1st Edition, Wiley Publications, 2015.
3. Donald A. Normann," Design of everyday things", Basic Books; 2nd Edition, 2013

Reference Books:

1. Rogers Sharp Preece,‖Interaction Design:Beyond Human Computer Interaction‖,,Wiley, 2019.
2. Guy A. Boy ―The Handbook of Human Machine Interaction‖, Ashgate publishing Ltd. 2017

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 Experiments:

Human Machine Interaction Laboratory (DJS23ALPE511)	
Sr No	**Title of Experiment**
1	A literature survey on Human Machine Interaction (based on IEEE/Scopus-Indexed Publication)
2	To Study of open-source UX tools (Justinmind Prototype, Pidoco, Marvel ,Figma Prototype) and create a simple design for a given problem definition.
3	Know your client. • Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector. • Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector. • Design a site that can help people to sell their handmade products in metro cities. • Design a site that can connect housewives and keep them engaged. Note : Students should be able to do the following for any given problem statement • Analysis of user's/client's behavior eg their preferences, interests etc • What kind of interfaces will they like and why? • Existing apps - analyze and rate them. • What will be your choice of screen elements? • How will your app/web design be better than the existing one?
4	Goal-oriented design - Design an experience for passengers whose flight /train is delayed.
5	Design Principles - Understand principles of good UI design by heuristic evaluation. Design UI for a given problem statement.
6	Menus & Navigation – Redesign of a user interface (Suggest and implement changes in Existing User Interface) for a given problem statement. a. Windows & Screen controls – Design UI for a given problem statement. b. Design a navigator for a student new in your Institute. c. Design a navigator for a person new in tourist city/ village. d. Motor paralysis for differently able people. e. Vaccination App design with localization
7	Icons - Design appropriate icons pertaining to a given domain. (Eg. Greeting cards, Travelling, restaurants, Education, Medical, security at Airport, Malls etc)
8	Colors – Design a personal website for any socio-technical problem. Use color guidelines with statistical graphics for better visualization.
9	Design a Map-based UI(Web User) for the given problem statement. Example: Mumbai Dabbawallas with localization feature. Pet Care New Visitors to Hospital
10	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 eight 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.

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: V
Course: Advanced Data Structures and Algorithm (DJS23ACPE512)		
Course: Advanced Data Structures and Algorithm Laboratory (DJS23ALPE512)		

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 (DJS23ACPE512)		
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	10

3	**Advanced Data Structures:** i. **Spatial Data Structure**: KD Tree, R Tree 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	06
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	06
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	39

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

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

Suggested List of Experiments:

Advanced Data Structures and Algorithm Laboratory (DJS23ALPE512)	
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 creation.
5	To implement Red Black Tree deletion.
6	To implement KD Tree
7	To implement Ford Fulkerson Algorithm
8	To implement Approximation Algorithms (Vertex Cover)
9	Experiment on Computational Geometry Algorithms (Graham Scan)

Minimum eight 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.

Program: Artificial Intelligence and Machine Learning	B.Tech.	Semester:V
Course: Recommendation Systems (DJS23ACPE513)		
Course: Recommendation Systems Laboratory (DJS23ACPE513)		

Prerequisite: Statistics for Data Science, and Machine Learning.

Course Objectives:

This course aims to provide a comprehensive understanding of recommendation system techniques, including collaborative, content-based, knowledge-based, and hybrid models. It equips students with the skills to design, implement, and evaluate personalized recommender systems across various applications using real-world data.

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. Analyze and differentiate various collaborative and content-based filtering techniques, including their algorithms, similarity functions, and limitations.
3. Apply knowledge-based and hybrid recommendation models to develop personalized recommendation solutions using constraint-based, case-based, or hybridization strategies.
4. Evaluate the performance of different types of recommender systems using offline and online evaluation paradigms and appropriate metrics.

Recommendation Systems (DJS23ACPE513)		
Unit	**Description**	**Duration**
1	**Introduction to Recommender System** Introduction to Recommendation System, Framework of recommendation systems, Eliciting Ratings and other Feedback Contributions, Implicit and Implicit Ratings, Recommender system functions. Applications of recommendation systems, Issues with recommender system	**06**
2	**Collaborative filtering-based Recommender System** Architecture of Collaborative Filtering, User-based nearest neighbour recommendation: Similarity Function, User-Based Algorithms, Item-based nearest neighbour recommendation: Similarity Function, Item-Based Algorithms, Comparing User-Based and Item-Based recommendations, data drift and concept drift.	**08**
3	**Content-based Recommender System:** Architecture of content-based systems, Content representation and content similarity, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, The Role of User Generated Content in the Recommendation Process. Bayes classifier for recommendation, Regression based recommendation system. Advantages and drawbacks of content-based filtering.	**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.	**06**
5	**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.	**06**
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.	**06**
	TOTAL	**39**

Books Recommended:

Textbooks:

1. C.C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1st Edition, 2016.
2. Jannach D., Zanker M. and FelFering A., "Recommender Systems: An Introduction", Cambridge University Press, 1st Edition, 2011
3. Ricci, F., Rokach, L., & Shapira, B., Introduction to Recommender Systems Handbook. Springer, Boston, MA 2011.

Reference Books:

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

Web Links:

1) https://tryolabs.com/blog/introduction-to-recommender-systems
2) https://medium.com/@deepapandithu/recommender-system-user-collaborative-filtering-37613f0c6a9

3) https://www.analyticsvidhya.com/blog/2015/08/beginners-guide-learn-content-based-recommender-systems/
4) https://www.researchgate.net/publication/2378325_Knowledge-Based_Recommender_Systems
5) https://medium.com/analytics-vidhya/7-types-of-hybrid-recommendation-system-3e4f78266ad8
6) https://www.researchgate.net/publication/226264572_Evaluating_Recommendation_Systems

List of Experiments:

Recommendation Systems Laboratory (DJS23ALPE513)	
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 Neighbours
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	Mini Projects: 1) Build a recommender system that suggests SDG-related content (articles, actions, or products) based on user preferences or content similarity. 2) Build a recommender system that suggests eco-friendly products or services aligned with specific SDGs. 3) Build a recommender system that suggests books aligned with specific SDGs, helping users find educational or informative literature related to sustainability, equality, or climate action.

Batch wise laboratory work of minimum eight 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.

Program: Artificial Intelligence and Machine Learning	B.Tech.	Semester:V
Course: Environmental Studies (DJS23ITHSX10)		

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.

Program: B. Tech in Artificial Intelligence & Machine Learning	T.Y.BTech	Semester: V
Course: Innovative Product Development III (DJS23IPSCX03)		

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.