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 (DJ19)

in

Artificial Intelligence (AI) and Data Science

(Semester VI)

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)

Sr. No.	Course Code	Course	Teaching Scheme(hrs)				Continuous Assessment (A) (marks)					Semester End Assessment (B) (marks)					Aggregate (A+B)	Total Credits
			Th	P	T	Credits	Term Test-1	Term Test-2	Term Test Avg.	T/W	Total CA (A)	Th	O	P	O &P	Total SEA		
1	DJ19ADC601	Deep Learning	3	--	--	3	25	25	25	--	25	75	--	--	--	75	100	4
	DJ19ADL601	Deep Learning Laboratory	--	2	--	1	--	--	--	25	25	--	--	--	25	25	50	
2	DJ19ADC602	Natural Language Processing	3	--	--	3	25	25	25	--	25	75	--	--	--	75	100	4
	DJ19ADL602	Natural Language Processing Laboratory	--	2	--	1	--	--	--	25	25	--	25	--	--	25	50	
3	DJ19ADC603	Computer Vision	3	--	--	3	25	25	25	--	25	75	--	--	--	75	100	4
	DJ19ADL603	Computer Vision Laboratory	--	2	--	1	--	--	--	25	25	--	25	--	--	25	50	
4	DJ19ADL604	Web and Social Media Analytics Laboratory	--	4	--	2	--	--	--	25	25	--	25	--	--	25	50	2
5@	DJ19ADC6011	MLOps	3	--	--	3	25	25	25	--	25	75	--	--	--	75	100	4
	DJ19ADL6011	MLOps Laboratory	--	2	--	1	--	--	--	25	25	--	25	--	--	25	50	
	DJ19ADC6012	Secure Software Systems	3		--	3	25	25	25	--	25	75	--	--	--	75	100	
	DJ19ADL6012	Secure Software Systems Laboratory		2	--	1	--	--	--	25	25	--	25	--	--	25	50	
	DJ19ADC6013	Distributed and Parallel Processing	3	--	--	3	25	25	25	--	25	75	--	--	--	75	100	
	DJ19ADL6013	Dsitributed and Parallel processing Laboratory	--	2	--	1	--	--	--	25	25	--	25	--	--	25	50	
	DJ19ADC6014	IoT and fog Computing Laboratory	3	--	--	3	25	25	25	--	25	75	--	--	--	75	100	
	DJ19ADL6014	IoT and fog Computing Laboratory	--	2	--	1	--	--	--	25	25	--	25	--	--	25	50	
6	DJ19IHL2	Professional and Business Communication LAB		4*		2	--	--	--	50	50	--	--	--	--	--	50	2
7	DJ19ILL2	Innovative Product Development IV	--	2	--	1	--	--	--	25	25	--	--	--	25	25	50	1
		Total	21	24	--	33	175	175	175	275	450	525	175	0	50	750	1200	21

Th	Theory	T/W	Termwork
P	Practical	O	Oral
T	Tuturial		

Prepared by Checked by Head of the Department Principal

Program: Third Year B.Tech. in Artificial Intelligence (AI) and Data Science	Semester: VI
Course: Deep Learning	Course Code: DJ19ADC601
Course: Deep Learning Laboratory	Course Code: DJ19ADL601

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	50
3	2	--	4	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	25	15	10	25	

Pre-requisite: Linear Algebra, Calculus, Probability, Statistics and Machine Learning Basics.

Course Objectives:

1. To introduce fundamental concepts of artificial neural network and different learning algorithms: supervised and unsupervised neural networks
2. Develop in-depth understanding of the key techniques in designing Deep Network and GAN.
3. To expose Deep Network based methods to solve real world complex problems.
4. To explore applications and challenges in deep learning

Outcomes: Students will be able to

1. Apply supervised and unsupervised deep learning algorithms
2. Implement deep network training and design concepts.
3. Build solution using appropriate neural network models.
4. Illustrate performance of deep learning models

Unit	Description	Duration
1	**Supervised Learning Networks:** Perceptron: Representational power of Perceptron, The Perceptron Training Rule, Gradient Descent and Delta Rule; Multilayer Networks: A differentiable Threshold Unit, Representational Power of Feedforward Networks; Backpropagation Algorithm: Convergence and local minima, Hypothesis space search and Inductive Bias, Generalization, overfitting and stopping criteria. Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Early Stooping, Sparse Representation, Dropout. Optimization for Training Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, and Parameter Initialization Strategies.	09
2	**Convolutional Neural Networks:** The Convolution Operation, sparse interactions, parameter sharing, Pooling, Convolution and Pooling as an Infinity Strong Prior, Variants of Basic Convolution Function, Efficient Convolution Algorithms **ConvNet Architectures:** Discussions on famous convnet architectures: AlexNet, ZFNet, VGG, GoogLeNet, ResNet InceptionNets, DenseNets	07
3	**Sequence Modelling:** Recurrent Neural Networks (RNN), Bidirectional RNNs, Deep recurrent Networks, Recursive Neural Networks, and the challenges of Long-Term Dependencies, Echo State Networks, Leaky Units, and The Long Short-Term Memory.	07
4	**Unsupervised Learning Networks:** Kohonen Self-Organizing Feature Maps – architecture, training algorithm, Kohonen Self-Organizing Motor Map. **Autoencoders:** Linear Factor Methods such as Probabilistic PCA and Factor Analysis, Independent Component Analysis, Sparse Coding; Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders.	07
5	**Generative Adversarial Networks:** Generative Vs Discriminative Modeling, Probabilistic Generative Model, Generative Adversarial Networks (GAN), GAN challenges: Oscillation Loss, Mode Collapse, Uninformative Loss, Hyperparameters, Tackling GAN challenges, Wasserstein GAN, Cycle GAN, Neural Style Transfer	06
6	**Applications of Deep Learning:** Deep learning in Finance, Deep learning in Healthcare, Deep learning in Computer Vision, Case Studies: case studies across different domains, challenges and future of deep learning directions in deep learning	03
	Total	**39**

Books Recommended:
Textbooks:

1. Dive into Deep Learning: Asaton Zhang, Zhacary Lipton, Mu Li and Alex Smola, December 2023
2. Understanding Deep Learning, Simon Prince, MIT Press, Dec2023
3. Simon Haykin, “Neural Networks and Learning Machines”, Pearson Prentice Hall, 3rd Edition, 2010.

4. S. N. Sivanandam and S. N. Deepa, “Introduction to Soft Computing”, Wiley India Publications, 3rd Edition, 2018.
5. David Foster, “Generative Deep Learning”, O’Reilly Media, 2019.
6. Denis Rothman, “Hands-On Explainable AI (XAI) with python”, Packt, 2020.

Reference Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, An MIT Press, 2016
2. François Chollet, “Deep Learning with Python”, Manning Publication, 2017.
3. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner's Approach”, O’Reilly Publication, 2017.
4. Andrew W. Trask, Grokking, “Deep Learning”, Manning Publication, 2019.
5. John D. Kelleher, “Deep Learning”, MIT Press Essential Knowledge series, 2019.

Web Links:

1. Learning Rule: http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/explist.php
2. ANN Virtual Lab: http://cse22-iiith.vlabs.ac.in/List%20of%20experiments.html
3. Deep Learning: https://vlab.spit.ac.in/ai/#/experiments
4. d2l.ai/d2l-en.pdf
5. NPTEL Course: Deep Learning Part https://onlinecourses.nptel.ac.in/noc19_cs85/preview

Suggested List of Experiments: -

Sr. No.	Title of the Experiment
1.	Implement Boolean gates using perceptron.
2.	Implement backpropagation algorithm from scratch.
3.	Monitoring and evaluating deep learning models using Tensor flow and Keras.
4.	Evaluate and analyze Prediction performance using appropriate optimizers for deep learning
5.	Building CNN models for image categorization.
6.	Visualizing Convolutional Neural Network using Tensor Flow with Keras Data.
7.	OCR using teassaeract
8.	Object detection using RNN using YOLO and Tensor Flow
9.	Anomaly detection using Self-Organizing Network.
10	Compare the performance of PCA and Autoencoders on a given dataset.
11	Build Generative adversarial model for fake (news/image/audio/video) prediction.
12	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

Evaluation Scheme:

Semester End Examination (A):

Theory*:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory*:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC601 including the practical performed during laboratory sessions of course DJ19ADL601.
2. Oral and practical examination will be of 25 marks

Continuous Assessment (B):

Theory:

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each paper is 1 hr.
Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 10 Marks
Miniproject:10 Marks
Journal Documentation (Write-up and solution of selected problem statement): 5 marks

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

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Artificial Intelligence (AI) and Data Science</td><td colspan="3">Semester: VI</td></tr>
<tr><td colspan="8">Course : Natural Language Processing</td><td colspan="3">Course Code: DJ19ADC602</td></tr>
<tr><td colspan="8">Course: Natural Language Processing Laboratory</td><td colspan="3">Course Code: DJ19ADL602</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
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<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Python Programming, Probability Mathematics

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.

Outcomes: Students will be able to

1. Understand the principles and Process the Human Languages Such as English and other Indian Languages using computers.
2. Creating CORPUS linguistics based on digestive approach (Text Corpus method)
3. Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.
4. Perform POS tagging for a given natural language and select a suitable language modelling technique based on the structure of the language.
5. Check the syntactic and semantic correctness of sentences using grammar and labelling.
6. Develop Computational Methods for Real World Applications and explore deep learning-based NL

Unit	Description	Duration
1	**Introduction to Natural Language Processing** Origin & History of NLP, Language, Knowledge, and Grammar in language processing, 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	**04**
2	**Computational tools for text analysis** Basic Terms: Tokenization, Stemming, 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. Data structures: strings and sequences Tokenization in the NLTK, Tokenizing text Stemming: Comparing stemmers Tagging: RE tagging, Trained taggers and backoff, Transformation-based tagging	**06**
3	**Word Level Analysis** Survey of English Morphology, Inflectional Morphology, Derivational Morphology, Regular expression with types, Morphological Models: Dictionary lookup, finite state morphology, Morphological parsing with FST (Finite State Transducer), Lexicon free FST Porter Stemmer algorithm, Grams and its variation: Bigram, Trigram, Simple (Unsmoothed) N-grams; N-gram Sensitivity to the Training Corpus, Unknown Words: Open versus closed vocabulary tasks, Evaluating N-grams: Perplexity, Smoothing: Laplace Smoothing, Good-Turing Discounting	**09**
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), Parsers: Top down and Bottom up; Modelling constituency; Bottom Up Parser: CYK, PCFG (Probabilistic Context Free Grammar).	**07**
5	**Semantic Analysis** Introduction, Meaning representation; Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babel net. 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), Introduction to Semi-supervised method (Yarowsky) Unsupervised (Hyperlex).	**07**
6	**Pragmatic & Discourse Processing** Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence;,Anaphora Resolution using Hobbs and Cantering Algorithm, Discourse segmentation, Conference resolution	**05**
	Total	**39**

Books Recommended:

Textbooks:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008
2. Christopher D.Manning and HinrichSchutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

3. Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O_Reilly Media, 2009

Reference Books:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008
2. Daniel M Bikel and ImedZitouni ― Multilingual natural language processing applications: from theory to practice, IBM Press, 2013.
3. Alexander Clark, Chris Fox, Shalom Lappin ― The Handbook of Computational
4. Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
5. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing,
6. Second Edition, Chapman and Hall/CRC Press, 2010.
7. Niel J le Roux and SugnetLubbe, A step by step tutorial: An introduction into R application and programming.

Suggested List of Experiments

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 & Chunking for the given input text.
3.	Perform morphological analysis and word generation for any given text
4.	Build a POS tagger using HMM
5.	Similarity Detection in NLP
6.	Implement N-Gram model for the given text input
7.	Generate word cloud using Python
8.	Any application of NLP : Spell Check, Autocorrect, plagiarism detection, sentiment analysis, sarcasm detection or text analytics in any domain

Evaluation Scheme:

Semester End Examination (A):

Theory*:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory*:*

1. Oral examination will be based on the entire syllabus of course DJ19ADC501 including the practical performed during laboratory sessions of course DJ19ADL602.
2. Oral examination will be of 25 marks.

Continuous Assessment *(B):*

Theory:

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each of the paper is 1 hr.

Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on the experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Performance of Experiments): 15 Marks

Journal Documentation (Write-up and solution of selected problem statement): 10 marks

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</table>

Prerequisite: Linear Algebra, Digital Signal Processing, Digital Image Processing

Course Objectives:

1. To develop a comprehensive understanding of computer vision and its real-world applications.
2. To apply methods to improve image quality and perform image analysis.
3. To study & implement algorithms of image segmentation and object detection
4. To apply methods to classify and analyze static & dynamic objects in image & videos.

Outcomes: students will be able to

1. Summarize the core concepts of computer vision and recognize its diverse applications.
2. Analyze and explain the principles of imaging geometry, radiometry, and digitization.
3. Recognize key image features and understand their importance in computer vision applications.
4. Implement techniques to analyze and process images effectively
5. Apply methods in pattern recognition, understand the significance of classifiers and their practical applications.
6. Utilize motion analysis techniques to track dynamic actions of objects in videos

Unit	Description	Duration
1	**Overview of Computer Vision and its Applications:** Fundamental of Image Processing, Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation, Applications of Computer Vision	04
2	**Image Features and Noise:** Points, corners, edges, Scale and orientation, Modeling image noise, Convolution, image smoothing, pyramid.	04
3	**Feature Extraction and Model Fitting:** Edges - Canny, LOG, DOG, Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Deformation, RANSAC, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.	08
4	**Object Segmentation and Detection:** Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation, Semantic segmentation, Scene Parsing, Clustering method for segmentation, Distance metrics, Linkage	09
5	**Clustering:** Hierarchical clustering methods for image segmentation, partitional Clustering Techniques: Fuzzy C-Means, K-Means, Histogram based thresholding, Meta-heuristic, Performance Evaluation parameters, Image segmentation bench mark datasets.	09
6	**Motion analysis and Action Detection:** Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation, Introduction to action recognition, Action classification, Action localization. Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.	05
	Total	**39**

Books Recommended:
Textbooks:

1. Rafael C. Gonzalez, "Digital Image Processing", Pearson, 2018 Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, Bishop_book.pdf (uoi.https://www.cs.uoi.gr/~arly/courses/ml/tmp/Bishop_book.pdfgr)
2. Richard Szeliski, Computer Vision Algorithms and Applications, The University of Washington,2022 (http://szeliski.org/Book/1stEdition.htm) for the 1st (2010) edition

Reference Books:

1. Introductory Techniques for 3D Computer Vision, Emanuele Trucco and Alessandro Verri, Prentice Hall.
2. Robot Vision, by B. K. P. Horn, MIT Press (Cambridge).
3. Computer Vision: Algorithms and Applications, by Richard Szeliski (freely downloadable!)
4. Computer Vision: A Modern Approach, Forsyth and Ponce, Pearson Education.
5. Concise Computer Vision: An introduction in Theory and Algorithms by Dr. Reinhard Klette Learning OpenCV 5 Computer Vision with Python by Joseph Howse and Joe Minichino

Useful Links:

1. https://www.cse.iitb.ac.in/~ajitvr/CS763_Spring2017/Adaboost_FaceDetection.pdf, Robust Real-time Face Detection, paper by Viola and Jones, International Journal of Computer Vision (2004).
2. https://computingforgeeks.com/best-books-to-learn-opencv-computer-vision/#google_vignette
3. https://onlinecourses.nptel.ac.in/noc22_ee48/preview/

Suggested List of Experiments:

Sr. No.	Title of the Experiment
1.	Image assessment with NumPy and OpenCV
2.	Image Transformation in OpenCV
3.	Feature Detection using OpenCV- Corner, Edge, Pyramid
4.	Image Denoising and enhancement techniques
5.	Object Detection
6.	Basic Video Processing in OpenCV
7.	Object Tracking
8.	Pattern Recognition
9.	Face Recognition
10	Motion analysis and Action detection
11	Project Based Learning
12	Research Article Review

Any other practical covering the syllabus topics and subtopics can be conducted.

Evaluation Scheme:
Semester End Examination (A):
Theory*:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory*:*

1. Oral examination will be based on the entire syllabus of course DJ19ADL603 including the practical performed during laboratory sessions of course DJ19ADL603 Oral examination will be of 25 marks.

Continuous Assessment (B):
Theory:
Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
Total duration allotted for writing each of the paper is 1 hr.
The average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)
Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
Journal Documentation (Write-up and solution of selected problem statement): 10 marks

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

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<tr><td colspan="8">Course : Web and social Media Analytics Lab</td><td colspan="3">Course Code: DJ19ADL604</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite: python

Course Objectives:

1. Understand and Apply Social and Web Analytics for Decision-making

Outcomes: Students will be able to

1. Identify and explain key metrics used in social and web analytics
2. Gain proficiency in collecting and preprocessing data from various sources, including social media platforms and websites, using tools and techniques such as APIs and web scraping.
3. Analyze web and social media performance data, interpret trends, and assess the effectiveness of online content and campaigns.
4. Develop the ability to make informed decisions based on analytics insights, including optimizing content strategies, improving user experience, and enhancing social media engagement.

Unit	Description	Duration
1	**Introduction to Digital Analytics** **Overview of Digital Analytics-**Understanding the role of analytics in the digital landscape Introduction to key web and social media metrics **Tools and Platforms-**Overview of popular analytics tools (Google Analytics, Adobe Analytics, Facebook Insights, etc.) Setting up accounts and basic configurations for web and social platforms **Case Study 1: Setting Up Digital Analytics** • Setting Up Digital Analytics • Hands-on experience with setting up Google Analytics for a website • Configuring basic tracking parameters for social media platforms	05
2	**Web Analytics Fundamentals** **Data Collection and Tracking-**Understanding cookies, tracking codes, and tags Implementing event tracking and goals in web analytics tools **Data Analysis Techniques-**Exploring segmentation, filtering, and custom reports, Analyzing user behavior and conversion funnels **Case Study 2: Advanced Web Tracking** • Implementing custom events and tracking user interactions • Analyzing user engagement with specific website elements	07
3	**Social Media Analytics Basics** **Key Social Media Metrics-**Understanding metrics such as likes, shares, comments, and engagement rate, Introduction to social media analytics terminology **Social Media Listening and Monitoring-**Setting up social media listening tools, Monitoring brand mentions and industry trends **Case Study 3: Social Media Metrics Analysis-**Analyzing the performance of social media metrics for a given brand, Identifying patterns and insights from social media data	09
4	**Advanced Social Media Analytics** **Sentiment Analysis-**Introduction to sentiment analysis tools and techniques, Analyzing the sentiment of social media mentions **Influencer Analysis-**Identifying and analyzing social media influencers Measuring the impact of influencer collaborations **Case Study 4: Sentiment Analysis and Influencer Identification: -**Performing sentiment analysis on social media mentions, Identifying and analyzing influencers for a specific brand or industry	12
5	**Integration of Web and Social Media Analytics** **Cross-Platform Tracking-**Integrating web and social media analytics data,Analyzing user journeys across different digital platforms **Attribution Modeling**-Understanding attribution models in the context of web and social media, Analyzing the customer journey from discovery to conversion **Case Study 5: Cross-Platform Analytics-**Integrating web and social media analytics for a comprehensive analysis, making data-driven recommendations based on the integrated insights	10
6	**Reporting, Visualisation, Testing** **Creating Comprehensive Reports-**Designing reports that cover both web and social media analytics, Presenting insights to stakeholders **Data Visualization Techniques-**Choosing the right visualizations for different types of data Creating dashboards that provide actionable insights **Case Study 6: A/B Testing for Web Content/social media: -**Determine the impact of different headlines on user engagement, determine whether images or videos generate higher engagement on social media.	09

	Identify the optimal times for posting on social media for maximum engagement.	
	Total	**52**

Books Recommended:

Textbooks:

1. "Social Media Data Mining and Analytics" edited by Gabor Szabo and Richard T. B. Ma (2018)
2. "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Instagram, GitHub, and More" by Matthew A. Russell (2019)

Reference Books:

1. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity by Avinash Kaushik, October 2009.
2. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media by Matthew Ganis, December 2015.

Online Recourses:

Learning Analytics Tools - Course (nptel.ac.in)

Suggested List of Experiments:

Sr. No.	Title of the Experiment
1.	**Website Traffic Analysis:** a. Analyze website traffic data to identify trends in user behavior over time, such as seasonal variations and day-of-the-week patterns. b. Segment website traffic based on geographical location to understand regional preferences and target specific markets effectively. c. Compare website traffic from different referral sources, such as organic search, social media, and email marketing, to identify the most effective channels for driving traffic.
2.	**Content Performance Evaluation:** a. Evaluate the effectiveness of different content formats, such as blog posts, articles, videos, and infographics, in attracting and engaging users. b. Analyze the impact of content length and complexity on user engagement metrics, such as time on page and bounce rate. c. Track the performance of content across different platforms, such as the website, social media, and email newsletters, to identify the most effective channels for content distribution.
4.	**Social Media Engagement Analysis:** a. Compare the effectiveness of different types of social media posts, such as images, videos, text-based posts, and live streams, in generating likes, shares, comments, and conversions. b. Analyze the impact of posting times and frequencies on social media engagement metrics to identify the most effective times to reach target audiences. c. Track the performance of social media campaigns using engagement metrics to measure the effectiveness of different campaign strategies and tactics.
5.	**Social Media Audience Segmentation:** a. Segment social media followers based on demographics, interests, and behavior to create

	targeted social media campaigns with personalized messaging and content. b. Analyze social media conversations to identify trends, sentiment, and key influencers within target audiences to inform social media strategies. c. Utilize social media analytics tools to identify and engage with high-value followers, such as brand advocates, influencers, and potential customers.
6.	**Social Media Campaign Evaluation:** a. Compare the effectiveness of different social media platforms, such as Facebook, Twitter, Instagram, and LinkedIn, for specific campaign goals, such as brand awareness, lead generation, and product sales. b. Experiment with different social media and targeting options, such as demographics, interests, and behaviors, to optimize campaign performance and reach the most relevant audiences. c. Track the return on investment (ROI) of social media campaigns by measuring the value generated from social media activities, such as website traffic, leads, and sales.
7.	Miniproject

Evaluation Scheme:

Laboratory*:*

1. Oral and practical examination will be based on the entire syllabus of practical performed during laboratory sessions of course DJ19ADL604.
2. Oral and practical examination will be of **25 marks**.

Continuous Assessment (B):
Laboratory: (Term work)
Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
Miniproject: 5 Marks
Journal Documentation (Write-up and solution of selected problem statement): 5 marks

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

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Artificial Intelligence (AI) and Data Science</td><td colspan="3">Semester : VI</td></tr>
<tr><td colspan="8">Course : MLops</td><td colspan="3">Course Code: DJ19ADC6011</td></tr>
<tr><td colspan="8">Course: MLops Laboratory</td><td colspan="3">Course Code: DJ19ADL6011</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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</table>

Pre-requisite:

1. Knowledge of Linux Operating system, installation and configuration of services and command line basics
2. Basics of Machine Learning
3. Knowledge Development Life cycle, development frameworks and DevOps

Course Objectives:

1.The objective of this course is to understand the fundamentals of MLOps and its significance in the ML lifecycle.

2. Students will Learn various tools and technologies used in MLOps to design and build scalable ML pipelines.
3. Students will get exposure to deploy ML models.
4. Students will learn techniques for monitoring, debugging, and optimizing ML systems.
5. Finally, students will explore methods for reproducibility, version control, and model governance

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

1. Automate the deployment of ML models into the core software system or as a service component
2. Deploy machine learning models in a production environment.
3. Implement model monitoring and performance evaluation.
4. Manage and scale machine learning infrastructure.
5. Apply industry best practices for MLOps and DevOps in data science.

Unit	Description	Duration
1	**Introduction to Machine Learning Operations** Overview of MLOps and its importance, Understanding the challenges in deploying and managing ML models, ML development lifecycle, Role of MLOps in the ML development lifecycle, Introduction to DevOps and its application to ML, MLOps in Practice.	06
2	**Data Management, Model Development and Training for MLOps** Model Development and Training for MLOps, Data versioning and reproducibility, Data preprocessing and feature engineering pipelines, Data validation and monitoring, Data quality assurance and governance, Model versioning and tracking, Model training pipelines and automation, Hyperparameter tuning and model selection, Model evaluation and validation techniques	06
3	**Model Deployment and Serving, Continuous Integration and Delivery (CI/CD) for ML** Model packaging and containerization (e.g., Docker), Infrastructure provisioning and orchestration (e.g., Kubernetes), Deploying models as scalable services, managing model endpoints and versioning, Version control and collaboration (e.g., Git), Building reproducible ML pipelines, Automated testing and code quality checks, Continuous integration and deployment strategies.	06
4	**Monitoring and Performance Optimization** Monitoring model performance and behavior, Real-time and batch monitoring techniques, Logging and error tracking in ML systems, Performance optimization and scalability considerations.	06
5	**Cloud Platforms and Infrastructure for MLOps** Introduction to cloud platforms (e.g., AWS, Azure, GCP), Deploying ML models on cloud infrastructure, managing resources and scaling ML workloads, Cost optimization strategies for ML systems.	08
6	**Governance and Compliance in MLOps** Data privacy and protection in ML systems, Access control and authentication mechanisms, Security considerations for model deployment, Compliance with industry regulations (e.g., GDPR, HIPAA).	07
	Total	**39**

Books Recommended:

Textbooks:

1. Noah Gift , "Practical MLOps: A Guide to Building Real-World Machine Learning Systems", O'Reilly, First Edition, September 2021.
2. Mark Treveil, Nicolas Omont, “Introducing MLOps: How to Scale Machine Learning in the Enterprise”, O'Reilly Media, First Edition, January 5, 2021
3. Emmanuel Raj, “Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale”, Packt Publishing Limited, 1st edition, 19 April 2021

Reference Books:

1. Hannes Hapke and Catherine Nelson, "Building Machine Learning Pipelines: Automating Model Life Cycles with TensorFlow", O’Reilly, First Edition, 19 July 2020.

2. Chris Fregly, Antje Barth, "Data Science on AWS: Implementing End-to-End Continuous Machine Learning Pipelines", O'Reilly, First Edition, 9 May 2021.
3. Sridhar Alla, Suman Kalyan Adari, "Beginning MLOps with MLFlow: Deploy Models in AWS SageMaker, Google Cloud, and Microsoft Azure", Apress publication, 1st edition, 8 December 2020.

Web Resources Blogs and Websites:

1. MLflow Blog: MLflow is an open-source platform for managing the ML lifecycle. The blog covers topics related to MLOps, model deployment, and reproducibility.
2. Towards Data Science: A popular online publication with a dedicated section on MLOps, featuring articles and tutorials on topics like model deployment, monitoring, and CI/CD pipelines.

Online Courses and Tutorials:

1. Coursera: "Machine Learning Engineering for Production (MLOps)" by deeplearning.ai. This course provides a comprehensive introduction to MLOps, covering topics like data and model versioning, deployment, monitoring, and more.
2. Udacity: "Machine Learning Deployment" by Google Cloud. This course focuses on deploying and scaling machine learning models using Google Cloud technologies and covers MLOps principles.
3. YouTube: You can find numerous tutorials and talks on MLOps from conferences and industry experts. Look for channels like TensorFlow, PyTorch, and DevOps-related channels.

Suggested List of experiments:

Sr. No.	Title of the Experiment
1.	**Case Studies and Best Practices** a. Real-world MLOps case studies b. Best practices and lessons learned c. Industry trends and emerging technologies in MLOps d. Future directions and challenges in the field
2.	**Setting up a Version Control System (VCS) for ML Projects:** a. Experiment with popular VCS tools like Git and create a repository for ML projects. b. Learn to track code changes, collaborate with team members, and manage different branches.
3.	**Creating a Continuous Integration (CI) Pipeline:** a. Build a CI pipeline using tools like Jenkins, Travis CI, or GitLab CI. b. Automate the process of building, testing, and validating ML models with each code commit.
4.	**Containerization with Docker:** a. Containerize ML models and their dependencies using Docker. b. Experiment with Docker images, containers, and Dockerfile configurations.
5.	**Orchestrating ML Workflows with Kubernetes**: a. Deploy ML models as scalable and resilient services using Kubernetes. b. Experiment with deploying, managing, and scaling ML workloads in Kubernetes clusters.
6.	**Experiment Tracking and Management:** a. Use tools like MLflow or Neptune.ai to track experiments, log metrics, and manage model versions. b. Explore features like hyperparameter tuning, model registry, and experiment reproducibility.
7.	**Continuous Deployment (CD) for ML Models:**

	a. Implement a CD pipeline to automate the deployment of ML models to production. b. Experiment with different deployment strategies, such as blue-green deployment or canary releases.
8.	**Monitoring and Alerting:** a. Set up monitoring and alerting systems to track model performance, data drift, and anomalies. b. Experiment with tools like Prometheus, Grafana, or DataDog to visualize and monitor ML system metrics
9.	**Model Performance Optimization:** a. Explore techniques for optimizing model performance, such as model quantization, pruning, or distillation. b. Experiment with different optimization approaches and measure their impact on model efficiency.
10.	**A/B Testing and Experimentation:** a. Design and conduct A/B tests to compare the performance of different ML models or algorithms. b. Experiment with statistical analysis and hypothesis testing to evaluate model improvem understand the importance of model governance and compliance in regulated industries. c. Experiment with model explainability, bias detection, and fairness assessment techniques.
11.	**Infrastructure as Code (IaC) for ML**: Use tools like Terraform or AWS CloudFormation to manage ML infrastructure. Experiment with provisioning and automating the setup of ML environments.

MLOps tools for model development, deployment, and monitoring to standardize, simplify, and streamline the machine learning process.

1. Tools for performing AutoML.[AutoGluon, AutoKeras, AutoPyTorch]
2. Data and Pipeline Versioning Tools [Pachyderm/ Data Version Control (DVC)]
3. Experiment Tracking and Model Metadata Management Tools (MLFlow/ Comnet ML/ Weights & Biases
4. End-to-End MLOps Platforms [AWS SageMaker/ DagsHub/ Kubeflow]
5. CI/CD for Machine Learning (clearML, CML)
6. Orchestration and Workflow Pipelines MLOps Tools [Prefect/ Metaflow/ Kedro]
7. Model Deployment and Serving Tools [TensorFlow Extended (TFX) Serving/ BentoML/ Cortex]
8. Model Testing & Validation [deepchecks/ trubrics]
9. Model Monitoring in Production ML Ops Tools [Evidently/ Fiddler/ Censius AI]

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC6011 including the practical performed during laboratory sessions of course DJ19ADL6011.
2. Oral and practical examination will be of **25 marks**.

Continuous Assessment (B):

Theory:

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
Total duration allotted for writing each of the paper is 1 hr.
Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
Journal Documentation (Write-up and solution of selected problem statement): 10 marks

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

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</table>

Course Objectives:

1. To develop proficiency in Secure Software Development and to implement comprehensive security measures.

Outcomes: Students will be able to

1. Conduct a comprehensive code review, identifying and remediating security vulnerabilities in a given codebase
2. Design and implement secure input validation and output encoding practices in a sample application.
3. Integrate multi-factor authentication into a sample authentication system and demonstrate a clear understanding of various authentication mechanisms.
4. Design and implement role-based access control (RBAC) for a sample application, ensuring the principle of least privilege.

Unit	Description	Duration
1	**Introduction to Information Security and Secure Software Development** Understanding the CIA triad (Confidentiality, Integrity, Availability), Overview of information security principles and goals, Overview of information security principles and goals, Introduction to security policies and risk management. Secure Software Development Lifecycle (SDLC): Stages of the SDLC and the role of security at each stage, integrating security into requirements, design, implementation, testing, and deployment, Case studies of security breaches and the impact on SDLC.	06
2	**Secure Coding Practices Secure coding guidelines and best practices**: Common programming vulnerabilities (e.g., buffer overflows, injection attacks), Coding in C String manipulation, vulnerabilities and exploits, Pointers based vulnerabilities. Coding C++ and JAVA - Memory management, common errors, Integer Security, Double free Vulnerabilities, Using secure coding standards (e.g., CERT, OWASP). Input Validation and Output Encoding: Importance of proper input validation, Techniques for output encoding to prevent Cross-Site Scripting (XSS) attacks, Secure handling of user inputs in different programming languages.	08

3	**Authentication and Authorization Authentication Mechanisms**: Types of authentications (e.g., passwords, biometrics, multi-factor), Secure storage and transmission of authentication credentials, Authentication best practices and common pitfalls. Authorization and Access Control: Principle of least privilege, Role-based access control (RBAC) and attribute-based access control (ABAC), Implementing fine-grained access controls	06
4	**Encryption and Data Protection Cryptography Basics**: Symmetric and asymmetric encryption, Key management and secure key exchange, Hash functions and digital signatures. Data Encryption in Applications: Implementing encryption for data at rest and in transit, Secure handling of sensitive data (e.g., PII, financial data), Compliance with data protection regulations	08
5	**Security Testing and Vulnerability Management Types of Security Testing:** Static analysis, dynamic analysis, and penetration testing,Automated vs. manual testing approaches, Tools for security testing (e.g., static analyzers, dynamic scanners). Vulnerability Management: Identifying and prioritizing vulnerabilities, Strategies for remediation and mitigation, Security metrics and reporting.	07
6	**Incident Response and Continuous Improvement Incident Response Planning**: Developing an incident response plan, Role of incident response teams and their responsibilities, Conducting tabletop exercises and simulations. Continuous Improvement in Security: Monitoring and adapting to emerging threats, incorporating lessons learned from security incidents, Security awareness programs and ongoing training.	07
	Total	**39**

Books Recommended:

Text books:

1. Suhel Ahamed Khan, Rajeev Kumar, Raees Ahamed Khan, SOFTWARE SECURITY CONCEPTS AND PRACTICES, A Chapman &Hall Book, CRC Press,2023

Reference Books*:*

1. Michael E. Whitman, Herbert J. Mattord," Principles of Information Security", Cengage Learning, 6 Jul 2021
2. Heather Adkins, Betsy Beyer, Paul Blankinship, Piotr Lewandowski Building Secure and Reliable Systems, Best Practices for Designing, Implementing, and Maintaining Systems, 2020, Orielly

Suggested List of Experiments:

Sr. No.	Title of the Experiment
1.	Conduct a risk assessment for a simple software system. Identify potential threats, vulnerabilities, and their impact. Propose risk mitigation strategies
2.	Draft a basic security policy for a fictitious organization. Consider access controls, password policies, and incident response.
3.	Analyse a codebase for common vulnerabilities. Identify and fix issues related to secure coding
4.	Implement input validation mechanisms for a sample application.Test the application with various input scenarios.
5.	Implement Multi-Factor Authentication (MFA). Integrate MFA into a simple authentication system.

6.	Design and implement RBAC for a sample application. Test and validate access controls based on different roles.
7.	Implement a simple encryption and decryption process.Experiment with symmetric and asymmetric encryption algorithms.
8.	Develop a secure data storage solution, encrypting data at rest.Explore techniques for securely managing encryption keys.
9.	Use a static analysis tool to scan code for potential vulnerabilities. Analyze and remediate identified issues. Conduct a simulated penetration test on a sample application. Identify and report vulnerabilities, suggesting mitigations
10.	Simulate an incident scenario (e.g., data breach, service outage). Practice the incident response plan and coordination. Develop a plan for a security awareness campaign

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory*:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC6012. including the practical performed during laboratory sessions of course DJ19ADL6012.
2. Oral and practical examinations will be of **25 marks**.

Continuous Assessment (B):

Theory:

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
Total duration allotted for writing each of the paper is 1 hr.
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<tr><td colspan="8">Course : Distributed and Parallel Processing</td><td colspan="3">Course Code: DJ19ADC6013</td></tr>
<tr><td colspan="8">Course: Course : Distributed and Parallel Processing Laboratory</td><td colspan="3">Course Code: DJ19ADL6013</td></tr>
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</table>

Pre-requisite:

Operating systems, programming language

Course Objectives:

1. Understand the Principles of Distributed Systems
2. Master Parallel Programming Techniques
3. Design and Implement Distributed Applications

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

1. Students will be able to analyze and design distributed systems, understanding the principles of distributed computing, communication protocols, and synchronization mechanisms.
2. They will apply parallel programming techniques to improve the performance of algorithms and solve computationally intensive problems, demonstrating proficiency in developing scalable and efficient parallel solutions.
3. Students will be able to design and implement distributed applications using parallel programming that are reliable, fault-tolerant, and scalable

Unit	Description	Duration
1	**Introduction to Distributed Systems** Introduction and examples of distributed systems, System models, Goals, Types of Distributed systems, Relation to parallel multiprocessor/multicomputer systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges, Introduction to remote communication, RPC basics, RPC implementation, RPC communication and issues, RMI basics, RMI implementation in java, Applications of Distributed systems: DFS, Distributed DBMS, Real-time Distributed Operating Systems	06
2	**Synchronization and Management** Clock synchronization, logical clocks, mutual exclusion, message ordering, Reliable group communication, deadlocks in distributed systems Resource Management, Task Assignment approach, Load balancing approach, load sharing approach, Introduction to process management, process migration, Threads	07
3	**Consistency, Replication and Fault Tolerance** Introduction, Data-Centric and Client-Centric Consistency Models, Replica Management Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Distributed Commit, Recovery	06
4	**Introduction to Parallel Computing** Introduction to Parallel Computing, Motivating Parallelism, Scope of Parallel Computing, Parallel architectures, Heterogeneous parallel computing, Speeding up real applications, Challenges and interfaces related to parallel programming, Performance considerations	07
5	**Parallel Programming Platforms** Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques	06
6	**Principles of Parallel Algorithm Design, advanced patterns and applications** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	07
	Total	**39**

Text Books:

1. Distributed Systems: Concepts and Design, G. Coulouris, J. Dollimore, and T. Kindberg, Pearson Education
2. Distributed Computing Principles, Algorithms and Systems, Ajay D. Kshemkalyani and Mukesh Singhal, CUP
3. Distributed Systems Principles and Paradigms, Andrew S. Tanenbaum, Marteen Van Steen
4. Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University Press
5. Parallel Programming in C with MPI and OpenMP by Micheal J. Quinn
6. Introduction to Parallel Computing, Second Edition By Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar

Reference Books:

1. Parallel Programming in MPI and OpenMP, The Art of HPC, volume 2, Victor Eijkhout, 2nd edition 2022, formatted March 9, 2023

2. Programming Massively Parallel Processors: A Hands-on Approach by Wen-mei W. Hwu, David B. Kirk and Izzat EI Haj

Suggested List of Experiment

Sr. No.	Title of the Experiment
1.	To implement client/server communication, use RPC/RMI for efficient distributed computing.
2.	To implement inter-process communication to enable seamless data exchange between concurrently running processes.
3.	To implement group communication mechanisms to ensure coordinated messaging among entities in a distributed system.
4.	To implement load balancing algorithms to optimize resource distribution for enhanced system performance.
5.	To implement name resolution protocols
6.	To implement clock synchronization algorithms to maintain consistent time across distributed systems for coordinated actions.
7.	To implement deadlock management strategies in distributed systems to prevent resource conflicts and ensure stability.
8.	To implement distributed file systems to organize and manage data across multiple networked servers for seamless access.
9.	To implement Floyd's Algorithm to efficiently find the shortest paths between all pairs of nodes in a graph.
10.	To implement matrix/matrix-vector multiplication algorithms for parallelized computations and efficient matrix operations.
11.	To implement sorting algorithms to organize data in a specified order for easier retrieval and analysis in distributed systems.
12.	To implement efficient signal processing and analysis, utilize the fast Fourier Transform in distributed computing.
13.	To implement the combination of MPI and OpenMP to harness parallelism for high-performance computing in distributed environments.
14.	Cuda basics (4 techniques)

Evaluation Scheme:

Semester End Examination (A):

Theory*:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory:

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC6013. including the practical performed during laboratory sessions of course DJ19ADL6013.
2. Oral and practical examinations will be of **25 marks**.

Continuous Assessment *(B):*

Theory:

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
Total duration allotted for writing each of the paper is 1 hr.
Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
Journal Documentation (Write-up and solution of selected problem statement): 10 marks

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

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Artificial Intelligence (AI) and Data Science</td><td colspan="3">Semester : VI</td></tr>
<tr><td colspan="8">Course : IoT and Fog Computing</td><td colspan="3">Course Code: DJ19ADC6014</td></tr>
<tr><td colspan="8">Course: Course : IoT and Fog Computing Laboratory</td><td colspan="3">Course Code: DJ19ADL6014</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td>Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td><td></td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">50</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">4</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>25</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Basics of Digital Electronics, Networking and programming basics

Course Objectives:

1. Thorough Comprehension of the IoT Ecosystem
2. Skillful Application of Edge Computing Techniques
3. Effective Implementation of Robust Security Measures for IoT and Edge Systems

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

1. Gain a comprehensive understanding of the Internet of Things (IoT) ecosystem, including key concepts, architectures, and communication protocols.
2. Examine the principles and advantages of edge computing in the IoT context, understanding its role in enhancing data processing efficiency and reducing latency.
3. Investigate and develop the unique security challenges of IoT devices and edge computing, including vulnerabilities, privacy concerns, and potential attack vectors.

Unit	Description	Duration
1	**Emergence of IoT, smart things and standards-** Background and Vision of IoT, Definition, Key Enabling Technologies, Need of an IoT thing, Commonly used smart things, A Simplified IoT Architecture, The Core IoT Functional Stack, Comparison of M2M and IoT, IoT reference Framework, IoT Network Level, LPWAN, Wireless technologies supporting IoT applications, Network Layer Encapsulation.	06
2	**Understanding the Nuts and Bolts of IoT Hardware, Software and Middleware-Sensors and Actuators in IoT:** Introduction, perception layer, understanding commonly used sensors, Environmental sensor, mechanical sensors, Flow and fluid measuring sensors, Range and Motion capture sensors, actuators **Open Hardware in IoT:** Prototyping Boards for IoT: SoC Classification based on Functionality, Arduino Boards, Raspberry Pi, BeagleBone, Comparison of Different Hardware Platforms **IoT Middleware:** Introduction, Architecture, State-of-the-Art IoT Middleware **IoT Software Platforms:** Need and Characteristics of IoT platforms, Commercial IoT Software platforms, Open IoT Software Platforms, Choosing and IoT Platform	07
3	**Industrial Internet of Things and Industry 4.0-**Introduction, Why Industrial Internet and why Now?, Industrial Internet Use-Cases: Healthcare, Oil and Gas Industry, Smart Office, IIoT Reference Architecture, Introducing Industry 4.0, Characteristics, The Value Chain, Design Principles, Building Blocks	06
4	**From the Core to the Edge-** The Sensor-Cloud vs. Sensors and the Cloud, Fog: The Next-Gen Cloud, Introduction, Characteristics, Advantages, Applications, Fog Architecture: The Comprehensive Framework, Mathematical Model of the System, Application Agnostic Fog Architectures, Application-Specific Fog Architectures	07
5	**Fog Computing-** The Hadoop philosophy for Fog computing, Comparing fog, edge, cloud, and mist computing, OpenFog reference architecture, EdgeX, Amazon Greengrass and Lambda, Fog topologies	06
6	**Securing IoT-**Introduction, Security issues in IoT Systems and Privacy Preservation, IoT security Requirements Based on CIA Principles, Security Technologies, IoT System Security Controls, Other Security Controls for IoT Systems, Best Prcatices for Securing IoT Devices, Misbehaviour in M2M communication	07
	Total	**39**

Text Books:

1. Internet of Things by Surya Durbha and Jyoti Joglekar by Oxford University Press, 2021.
2. Sensors, Cloud and Fog: The Enabling Technologies for th Internet of Things by Sudip Misra, Subhadeep Sarkar and Subarna Chatterjee by CRC Press, 2019.
3. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist by Apress, 2023.
4. IoT and Edge Computing for Architects by Perry Lea, Second edition, by Packt, 2020.
5. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry by Cisco press, 2017.

Reference Books:

1. 21 IoT Experiments by Yashwant Kanetkar by BPB Publications, 2018.
2. Internet-of-Things (IoT) Systems: Architectures, Algorithms and Methodologies by Dimitrios Serpanos and Marilyn Wolf by Springer,2018.
3. Internet of Things: A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti by Universities Press, 2014.
4. Internet of Things: Architecture and Design Principles by Raj Kamal by Mc Graw Hill, 2022.

Suggested List of Experiments:

Sr. No	Title of the Experiment
1	To implement simple data collection using IoT devices.
2	To Understand, implement and compare communication protocols used in IoT like MQTT, CoAP.
3	To Set up edge devices and servers.
4	To develop an edge computing application for a specific industry (e.g., healthcare, manufacturing).
5	To implement analytics and decision-making processes at the edge.
6	To explore security concerns in IoT and edge computing.
7	To implement encryption and authentication for secure IoT communication.
8	To implement and IoT setup to send the data on the cloud.
9	To integrate IoT, Edge computing and Cloud computing.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

Laboratory*:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC6014. including the practical performed during laboratory sessions of course DJ19ADL6014.
2. Oral and practical examination will be of **25 marks**.

Continuous Assessment (B):

Theory:

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each of the paper is 1 hr.

Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)
Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
Journal Documentation (Write-up and solution of selected problem statement): 10 marks

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<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Artificial Intelligence (AI) and Data Science</td><td colspan="2">Semester : VI</td></tr>
<tr><td colspan="8">Course : Professional And Business Communication Lab</td><td colspan="2">Course Code: DJ19IHL2</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="6">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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<tr><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2">-</td><td>50</td></tr>
</table>

*2 hrs. Theory (Class wise) and 2 hrs. Tutorial (Batch wise)

Pre-requisite:

Basic course in Effective Communication Skills

Course Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance communication and interpersonal skills
3. To develop effective presentation skills
4. To hone written skills for technical documentation

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

1. Plan, organize and write technical documents like reports, proposals and research papers in the prescribed format using appropriate language and style with an understanding of ethics in written communication
2. Apply techniques of writing resume, participating in a group discussion and facing interviews
3. Demonstrate interpersonal skills in professional and personal situations
4. Articulate the documentation process of meetings and conduct meetings in a professional manner
5. Explain communication across cultures and work ethics
6. Design and deliver effective presentations using Power Point

Unit	Description	Duration
1	**Technical Writing** **Report Writing**: Types of reports, Basic structure of a report, collection of data through questionnaires, survey analysis, language and style in reports **Business Proposal Writing:** Types of business proposals, format of proposal, language and style, presentation of proposal **Plagiarism**: Types of plagiarism, consequences of plagiarism	06
2	**Employment Skills** **Group Discussion**: Purpose of a GD, types of GD, criteria for evaluating GD, Dos and Don'ts of GD **Resume Writing**: Types of resumes, structure, content and formatting of resume **Interview Skills**: Types and modes of interview, Preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview **Presentation Skills**: Presentation strategies, overcoming stage fear, techniques to prepare effective PowerPoint presentation	08
3	**Corporate Story Telling** **Planning and preparation for meetings**: Planning layout of meetings, arranging logistics, defining roles and responsibilities **Strategies for conducting effective meetings**: Follow the agenda, record discussion, observe meeting decorum **Documentation**: Draft notice, agenda and minutes of meeting **Business meeting etiquettes:** Verbal and non-verbal aspects of etiquettes	03
4	**Meetings and Documentation** **Planning and preparation for meetings**: Planning layout of meetings, arranging logistics, defining roles and responsibilities **Strategies for conducting effective meetings**: Follow the agenda, record discussion, observe meeting decorum **Documentation**: Draft notice, agenda and minutes of meeting **Business meeting etiquettes:** Verbal and non-verbal aspects of etiquettes	02
5	**Introduction to Interpersonal Skills** **Emotional Intelligence**: Definition, difference between IQ and EQ, how to develop EQ **Leadership**: Types of leadership, leadership styles, case studies **Team Building**: Difference between group and team, importance of teamwork, strategies to be a good team player **Time Management**: Importance of time management, cultural views of time, 80/20 rule,	05
6	**Cross-cultural communication and Professional ethics** **Communication across cultures**: Understanding cultures and developing sensitivity towards cultural differences corporate etiquettes: Telephone, dining, cubicle etiquette, etc. Professional ethics: Effective work habits, accountability, integrity and excellence	02

Books Recommended:

Reference Books*:*

1. Fred Luthans, "Organizational Behavior", McGraw Hill, edition
2. Lesiker and Petit, "Report Writing for Business", McGraw Hill, edition
3. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw Hill
4. Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 12th edition
5. Heta Murphy, "Effective Business Communication", Mc Graw Hill, edition

6. Sharma R.C. and Krishna Mohan, "Business Correspondence and Report Writing", Tata McGrawHill Education
7. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill. Lehman,
8. Bell, Smith, "Management Communication" Wiley India Edition, 3 rd edition.
9. Dr. Alex, K.," Soft Skills", S Chand and Company
10. Subramaniam, R., "Professional Ethics" Oxford University Press.
11. Sandeep Das, "How Business Story Telling Works: Increase Your Influence and Impact" Penguin Random House India Pvt. Ltd.

Evaluation Scheme: Laboratory: (Term work) Term work shall consist of 6 assignments, Group Discussion and Power Point Presentation based on the Business Proposal. The distribution of marks for term work shall be as follows: Tutorials (25) Marks
Business Proposal (15)
Marks Group Discussion (10) Marks
TOTAL: (50) Marks
The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

Program: Third Year B.Tech. in Artificial Intelligence (AI) and Data Science							Semester : VI			
Course : Innovative Product Development-IV (C)							Course Code: DJ19ILL2			
Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				--			--	--	--	--
				Laboratory Examination			Term work		Total Term work	50
--	2	--	1	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	25	15	10	25	

Course Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

Outcome: Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualising a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyse the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- 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.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters V and VI.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- 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.
- Distribution of term work marks during the subsequent semester shall be as given below:
- Marks awarded by the supervisor based on log-book :10
- Marks awarded by review committee: 10
- Quality of the write-up: 05

In the last review of the semester VI, the term work marks will be awarded as follows.

- Marks awarded by the supervisor (Considering technical paper writing): 15
- Marks awarded by the review committee: 10

Review/progress monitoring committee may consider the following points during the assessment.
In the semester V, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.

- First shall be for finalisation of the product selected.
- Second shall be on finalisation of the proposed design of the product.

In the semester VI, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.

- First review is based on readiness of building the working prototype.
- Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;

- Quality of survey/ need identification of the product.
- Clarity of Problem definition (design and development) based on need.
- Innovativeness in the proposed design.
- Feasibility of the proposed design and selection of the best solution.
- Cost effectiveness of the product.
- Societal impact of the product.
- Functioning of the working model as per stated requirements.
- Effective use of standard engineering norms.
- Contribution of each individual as a member or the team leader.
- Clarity on the write-up and the technical paper prepared.

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

Guidelines for Assessment of Semester Reviews:

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

The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester IV.Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester

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