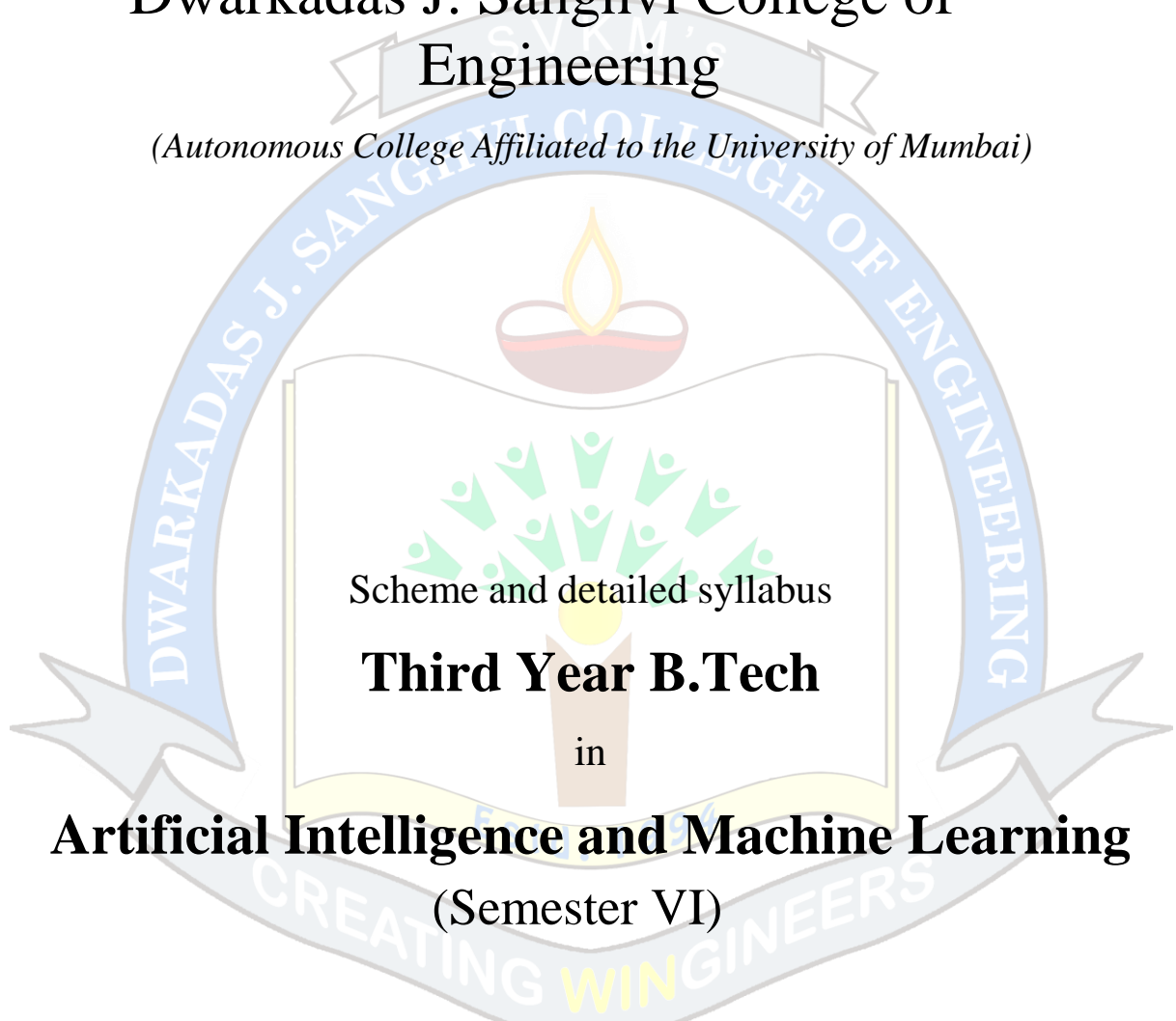Shri Vile Parle Kelavani
Mandal's

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 VI)

Academic Year 2024-25

Proposed Scheme for Third Year Undergraduate Program in Artificial Intelligence and Machine Learning: Semester VI (Autonomous)
Academic Year(2024-25)

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	Th	T/W	Total CA (A)	Th	O	P	O &P	Total SEA (B)		
1	DJS22AMC601	Computer Vision	3	--	--	3	35	--	35	65	--	--	--	65	100	4
	DJS22AML601	Computer Vision Laboratory	--	2	-	1	--	25	25	--	--	--	25	25	50	
2	DJS22AMC602	Deep Learning	3	--	--	3	35	--	35	65	--	--	--	65	100	4
	DJS22AML602	Deep Learning Laboratory	--	2	--	1	--	25	25	--	25	--	--	25	50	
3	DJS22AMC603	Dev Ops and ML Ops	3	--	--	3	35	--	35	65	--	--	--	65	100	4
	DJS22AML603	Dev Ops and ML Ops Laboratory		2	--	1	--	25	25	--	25	--	--	25	50	
4	DJS22AML604	Cloud Computing Laboratory	--	2	--	1	--	25	25	--	25	_	_	25	50	1
5@	DJS22AMC6011	IoT Foundations	3	--	--	3	35	--	35	65	--	--	--	65	100	4
	DJS22AML6011	IoT Foundations Laboratory	--	2	--	1	--	25	25	--	25	--	--	25	50	
	DJS22AMC6012	Time Series Analysis	3	-	--	3	35	--	35	65	--	--	--	65	100	
	DJS22AML6012	Time Series Analysis Laboratory	_	2	-	1	--	25	25	--	25		--	25	50	
	DJS22AMC6013	Human Machine Interaction	3	--	--	3	35	--	35	65	--	--	--	65	100	
	DJS22AML6013	Human Machine Interaction Laboratory	--	2	--	1	--	25	25	--	25	--	--	25	50	
6#	DJS22IHL	Professional and Business Communication Laboratory	--	4	--	2	--	50	50	--	--	--	--	--	50	2
7	DJS22ILLL2	Innovative Product Development IV	--	2	--	1	--	25	25	--	--	--	25	25	50	1
		Total	12	16	--	20	140	200	340	260	100	--	50	410	750	20

@Any 1 Elective Course

#2 hrs. of theory (class wise) and 2 hrs of activity based laboratory(batch wise)

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

Prepared by   Checked by   Head of the Department   Vice Principal   Principal

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
Theory	One Term test (based on 40 % syllabus)	35	1
	Second Term test (next 40 % syllabus) / presentation / assignment / course project / group discussion / any other.		
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.	25	

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

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	65	3
	* 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

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: Computer Vision(DJS22AMC601)		
Course: Computer Vision Laboratory (DJS22AML601)		

Pre-requisite: 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 image feature detection and noise reduction methods to improve image quality, to extract features and perform model fitting methods to analyze and process images.

3. To implement segmentation and object detection algorithms to identify and locate objects in images.

4. To implement pattern recognition methods to classify and analyze data and motion analysis and action detection methods to track and recognize dynamic objects in videos.

Course Outcomes: Upon completion of this course, students will be able to:

1. Explain the fundamentals of computer vision, including imaging geometry, transformations, and image formation, and analyze low-level image processing techniques for feature detection and noise modelling.
2. Apply advanced feature extraction techniques such as Canny, SIFT, SURF, and HOG, and evaluate model fitting methods like RANSAC and Hough Transform for object recognition and image analysis.
3. Demonstrate object segmentation and detection using techniques such as region growing, graph-cut, and semantic segmentation, and develop solutions for clustering and texture analysis in computer vision applications.
4. Utilize supervised, unsupervised, and deep learning models such as CNNs, RNNs, and YOLO to design and implement vision-based pattern recognition and transfer learning systems.
5. Analyse 3D data representation, stereo vision, and 3D reconstruction methods, and construct solutions for shape inference using photometric stereo, optical flow, and other shape-from-X techniques.

Computer Vision (DJS22AMC601)		
Unit	Description	Duration
1	**Overview of Computer Vision and its Applications:** Geometries and basic transformation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation.	3

	Image Formation and Representation	
2	**Image Features and Noise:** Low level processing: Segmentation, Points, corners, edges, pyramid, Scale and orientation, Types of Image Noise, Modeling image noise, Convolution, image smoothing.	4
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.	8
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.	9
5	**Pattern Recognition:** Use of Supervised, unsupervised and semi supervised learning in Computer Vision; Deep Learning Models for Computer Vision: CNNs, RNNs, R-CNNs; Transfer Learning; YOLO; Attention Mechanism in Computer Vision.	7
6	**3-D Computer Vision:** Sources of 3D Data sets, Slicing, Arbitrary section planes, Color display, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing and Measurements in 3D. Multiple Image: Stereo, Epipolar Geometry, Stereo Essential and Fundamental Matrices, Multiview stereo, Triangulation, Correspondence, Rectification, 3D Reconstruction. Shape from X: Reflectance map, Shape from shading, Photometric stereo, Shape from optical flow, Rotating camera, Silhouettes.	8
	TOTAL	39

Books Recommended:

Text Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition ,Springer-Verlag London Limited 2022.
2. Rajeev Ratan, Hands-On Computer Vision with OpenCV, Keras, and TensorFlow, 1st edition, Packt Publishing, 2021

3. E. R. Davies, Computer Vision: Principles, Algorithms, Applications, Learning, 5th Edition, Academic Press Publisher, 2018.

Reference Books:
1. Hafsa Asad, Vishwesh Shrimali, Nikhil Singh, The Computer Vision Workshop, 1st edition, Packt Publishing, 2022
2. Katsushi Ikeuchi, Computer Vision: A Reference Guide, 2nd edition, Springer Publishing, 2021
3. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, Pearson Education, 2nd Edition, 2015.
4. Scott Krig, Computer Vision Metrics: Survey, Taxonomy, and Analysis, 1st edition, Apress, Publisher, 2014.

Useful Links:
1. Advances in Computer Vision : 6.869 Course Materials (mit.edu)
2. Machine Vision | Electrical Engineering and Computer Science | MIT OpenCourseWare
3. vision.stanford.edu
4. Computer Vision Notes (Faisal Z. Qureshi at Ontario Tech University) (uoit.ca)
5. Deep Learning for Computer Vision - Course (nptel.ac.in)
6. Computer Vision Basics | Coursera
7. Introduction to Computer Vision and Image Processing | Coursera

Suggested List of Experiments:

Computer Vision Laboratory (DS22AML601)	
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	Optical Flow computation algorithm
11	3D Image Reconstruction
12	Project Based Learning
13	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

Prepared by   Checked by   Department Coordinator   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: Deep Learning (DJS22AMC602)		
Course: Deep Learning Laboratory (DJS22AML602)		

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. Understand the fundamentals of deep neural networks and their training mechanisms.
2. Apply optimization and regularization techniques to improve model performance.
3. Design and implement CNN models for supervised learning tasks.
4. Develop solutions for sequence learning applications using recurrent networks.
5. Analyze unsupervised learning techniques for dimensionality reduction and data reconstruction.
6. Evaluate recent trends in adversarial networks and generative models.

Deep Learning (DJS22AMC602)		
Unit	Description	Duration
1	**Supervised Learning Networks Feedforward DNN** Perceptron: Representational power of Perceptron, The Perceptron Training Rule, Multilayer perceptron: Delta training rule; Multilayer Networks: A differentiable Threshold Unit (Sigmoid Neurons), Representational Power of Feedforward Networks; Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function	07
2	**Optimization:** Learning with backpropagation: EBPTA, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp, Convergence and local minima, stopping criteria. **Regularization:** Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Early Stooping, Sparse Representation, Dropout.	07

3	**Convolutional Neural Networks:** Convolution operation, Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function, 2D Convolution. **ConvNet Architectures:** LeNet: Architecture, AlexNET: Architecture, ResNet : Architecture, ConvNeXt, EfficientNET, **Applications:** object detection and recognition tasks, medical image analysis, image classification.	06
4	**Sequence Modelling:** Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Limitation of "vanilla RNN", Vanishing and Exploding Gradients, The Long Short-Term Memory, GRU, Deep recurrent Networks. **Applications:** Sentiment analysis, stock prices or market trends	06
5	**Unsupervised Learning Networks:** Kohonen Self-Organizing Feature Maps – architecture, training algorithm **Autoencoders:** Introduction, comparison with PCA, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders, Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders, Variational Autoencoders (VAEs) **Applications:** image compression, feature extraction, risk assessment and fraud detection	07
6	**Adversarial Networks** Generative Vs Discriminative Modeling, Generative Adversarial Networks (GAN) Architecture, GAN challenges: Oscillation Loss, Mode Collapse, Uninformative Loss, Hyperparameters, Tackling GAN challenges, Wasserstein GAN, Cycle GAN, Neural Style Transfer, Diffusion Models: Introduction, Comparison with GANs. Applications: image synthesis or style transfer, Data Augmentation	06
	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. M. J. Kochenderfer, Tim A. Wheeler. ―Algorithms for Optimization‖, IT Press.

6. David Foster, "Generative Deep Learning", O'Reilly Media, 2019.

7. 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.

6.Douwe Osinga. ―Deep Learning Cookbook‖, O'REILLY, SPD Publishers, Delhi

Web Resources:

1.Deep Learning: https://vlab.spit.ac.in/ai/#/experiments

2.Deep learning book https://www.deeplearningbook.org/

3.Deep learning all videos: https://www.cse.iitm.ac.in/~miteshk/CS6910.html

4.Deep Learning Specialization: https://www.coursera.org/specializations/deep-learning

Online Resources

1. *Deep Learning, IIT Ropar NPTEL course by Prof. Sudarshan Iyengar,Dr. Padmavati* *https://nptel.ac.in/courses/106106184*

Suggested List of Experiments: -

Deep Learning Laboratory (DJS22AML602)	
Sr. No.	Title of the Experiment
1.	Implement Boolean gates using perceptron.
2.	Implement representation power of perceptron.
3.	Implement backpropagation algorithm from scratch.
4.	Train CNN Models for Image Classification Tasks.
5.	Evaluate the Effect of Optimizers (SGD, Adam) on Model Performance.
6.	Compare the Performance of PCA and Autoencoders on Dimensionality Reduction Tasks.
7.	Sequence Classification Using RNN or GRU (e.g., Sentiment Analysis or Activity Recognition).
8.	Anomaly detection using Self-Organizing Network.
9.	Compare the performance of PCA and Autoencoders on a given dataset.

10	Train Variational Autoencoders (VAEs) for Image Reconstruction.
11	Build Generative adversarial model for fake (news/image/audio/video) prediction.
12	Generate Synthetic Data Using Diffusion Models and Evaluate Results.
13	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.

Prepared by   Checked by   Head of the Department   Vice Principal   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI

Course: Dev Ops and ML Ops (DJS22AMC603)

Course: Dev Ops and ML Ops Laboratory (DJS22AML603)

Prerequisite: Machine Learning.

Course Objectives:

1. To understand the need for DevOps as a software engineering practice.
2. To know and understand the concept of Continuous Integration Continuous Delivery (CICD).
3. To learn the concept of continuous deployment and monitoring strategies.
4. To learn various tools used in DevOps
5. To comprehend the concepts in MLOps
6. To learn deployment strategies in MLOps

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

1. Understand the fundamental concepts of DevOps
2. Comprehend the concept of continuous integration and continuous delivery
3. Compare various stages of continuous deployment and monitoring strategies
4. Explore various tools to implement concepts in DevOps
5. Describe the concepts used in the automation of Machine Learning life cycle phases
6. Elaborate deployment strategies in MLOps

Dev Ops and ML Ops (DJS22AMC603)		
Unit	Description	Duration
1	**Introduction to DevOps and the Culture:** Definition, History of Devops, Objectives, Role of DevOps Engineer, Developer responsibility, Continuous Integration & Deployment, Containers and Virtual Development, Configuration Management Tools, Introduction to DevOps pipeline phases, Defining the Development Pipeline, Centralizing the Building Server, Monitoring Best Practices and Best Practices for Operations.	**06**
2	**Source Code Management:** Version Control: GIT Features, 3-Tree Architecture, GIT – Clone /Commit / Push, GIT Hub Projects, GIT Hub Management, GIT Rebase & Merge, GIT Stash, Reset, Checkout, GIT Clone, Fetch, Pull, Membership GITHUB. **Continuous Integration and Continuous Delivery:** Implementing Continuous Integration-Version control, automated build, Continuous Integration Practices using Continuous Integration Software (Jenkins as an example tool), Jenkins Architecture, Integrating	**06**

	Source code management, Continuous delivery to a staging environment or the pre-production, environment, Self-healing systems.	
3	**Continuous Deployment and Continuous Monitoring**: **Implementing a testing Strategy:** Types of Tests, Integration testing, managing defect backlogs, **Continuous Deployment:** Trade-offs in the deployment pipeline, Basic Deployment pipeline, Deployment pipeline practices & Commit stage, Automated Acceptance Test Gate, **Factors involved in monitoring systems:** white-box and black-box monitoring, building a monitoring system, monitoring infrastructure and applications, collecting data, logging, creating the dashboard, behaviour-driven monitoring, Site reliability engineering, SRE and DevOps, roles, and responsibilities of SRE, common tools used by SREs.	06
4	**Configuration Management:** The Process of Configuration in Devops. **Configuration Management Tools Containerization:** Docker introduction, Docker Image, working with Docker Containers, Docker Engine, Creating Containers with an Image, working with Images, Docker Hub, Docker Trusted Registry, Docker File & Commands. Devops Monitoring Tool: Introduction to Nagios, Architecture **Virtualization and Containerization:** Virtualization, Virtualization vs Containerization, Micro-services and Containerization, orchestration, Difference between orchestration and automation.	07
5	**Introduction to MLOps:** MLOps Motivation, Solutions and Future Trends, MLOps Components, Different Roles involved in MLOps (ML Engineering + Operations), Machine Learning Life Cycle, MLOps Vs DevOps, Tools to create ML pipelines	07
6	**ML Model Deployment:** MLOps Maturity Model Levels, MLOps - Stages Of CI / CD, Creating and deploying ML/AI models, ML Pipelines, automation of ML through Pipelines, Tools to create ML pipelines, Monitoring and Logging, Data Quality and Integrity, Model Retraining and Model replacement, Model Versioning, MLOps: Infrastructure, MLOps: Testing, Monitoring and Maintenance	07
	TOTAL	**39**

Books Recommended:

Textbooks:

1. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication, 2nd edition, 2018.
2. PierluigiRiti, "Pro DevOps with Google Cloud Platform", Apress, ISBN: 978-1-4842-3896-7.
3. Gene Kim, Kevin Behr, George Spafford "The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business" It Revolution Press publication, 2018.

4. Gene Kim, Patrick Debois, John Willis, Jez Humble "The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations" IT Revolution Press, 2021.

5. Noah Gift , "Practical MLOps: A Guide to Building Real-World Machine Learning Systems", O'Reilly, First Edition, September 2021.

Reference Books:

1. Viktor Farcic, "The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices"

2. Jennifer Davis and Katherine Daniels, "Effective DevOps: Building a Culture of Collaboration, Anity, and Tooling at Scale", O'Reilly Media, Inc., ISBN: 978-1-491-92630-7

3. Sanjeev Sharma and Bernie Coyne, "DevOps for Dummies", John Wiley & Sons, Inc., 2nd IBM Limited Edition, ISBN: 978-1-119-04705-6

4. Sridhar Alla, Suman Kalyan Adari, Beginning MLOps with MLFlow: Deploy Models in AWS SageMaker, Google Cloud, and Microsoft Azure

5. Mark Treveil, Nicolas Omont, "Introducing MLOps: How to Scale Machine Learning in the Enterprise", O'Reilly Media, First Edition, January 5, 2021

6. Chris Fregly, Antje Barth, "Data Science on AWS: Implementing End-to-End Continuous Machine Learning Pipelines", O'Reilly, First Edition, 9 May 2021.

Web Links:
1. https://www.redhat.com/en/resources/cloud-native-container-design-whitepaper
2. https://www.redhat.com/en/topics/cloud-native-apps/what-is-serverless
3. https://www.redhat.com/en/topics/automation/what-is-orchestration
4. https://www.atlassian.com/continuous-delivery/continuous-integration
5. https://www.flagship.io/glossary/site-reliability-engineer/
6. https://docs.microsoft.com/en-us/learn/paths/intro-to-vc-git/
7. https://www.javatpoint.com/kubernetes
8. https://www.javatpoint.com/docker-tutorial
9. https://www.javatpoint.com/jenkins
10. https://www.javatpoint.com/jenkinss
11. https://www.javatpoint.com/ansible
12. https://www.javatpoint.com/selenium-tutorial
13. https://prometheus.io/docs/introduction/overview/
14. https://www.javatpoint.com/jira-tutorial
15. https://www.geeksforgeeks.org/what-is-elastic-stack-and-elasticsearch/
16. Coursera: Machine Learning Engineering for Production (MLOps) Specialization by Andrew Ng
17. Coursera: "Machine Learning Engineering for Production (MLOps)" by deeplearning.ai.
18. Udacity: "Machine Learning Deployment" by Google Cloud.

Suggested List of Experiments:

Dev Ops and ML Ops Laboratory (DJ19AML603)	
Sr. No.	**Title of the Experiment**
1	Write code for a simple user registration form for an event. To Study DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities
2	To carry out Version Control System / Source Code Management, install git and create a GitHub account.
3	To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet
4	Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
5	To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
6	To Setup and Run Selenium Tests in Jenkins Using Maven.
7	To study Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
8	To study Dockerfile instructions, build an image for a sample web application using Dockerfile.
9	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
10	To perform Software Configuration Management and provisioning using Puppet Blocks (Manifest, Modules, Classes, Function).
11	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.
12	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
13	Containerization with Docker: a) Containerize ML models and their dependencies using Docker. b) Experiment with Docker images, containers, and Dockerfile configurations
14	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.
15	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

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.

Prepared by　　　　　Checked by　　　　　Department Coordinator　　　Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: Cloud Computing Laboratory (DJS22AML604)		

Course Objective:
1. To familiarize with cloud computing terminologies and industry standards.
2. To gain Hands-on experience in virtualizing resources in a cloud environment.
3. To introduce the best practices for securing cloud services and managing user access.
4. To Introduce distributed database design principles and techniques.

Course Outcomes: On completion of the course, the students will be able to:
1. Understand the fundamental concepts and principles of cloud computing.
2. Use virtualization technologies and tools.
3. Understand the concept of identity and access management in cloud computing.
4. Utilize big data processing frameworks such as Hadoop, Spark, and Flink to process and analyze large datasets.

Cloud Computing Laboratory (DJS22AML604)		
Unit	**Description**	**Duration**
1	**Introduction to Cloud Computing:** Overview of cloud computing, Fundamentals of cloud computing ecosystem, cloud computing characteristics, Components of cloud computing, peer-to-peer, client-server, grid computing, Cloud Architecture, Introduction to distributed computing, need of distributed computing, Introduction to Parallel computing, Parallel computing platforms.	4
2	**Cloud Services and Deployment Models:** Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS), NIST Model for cloud, Public cloud, Private cloud, Hybrid cloud, Community cloud. Computing services, Storage services, Networking services, Database services. **Virtualization:** Full Virtualization, Para-Virtualization, Hardware/ Memory Virtualization, KVM architecture. **Cloud Infrastructure mechanism**: Logical network perimeter, virtual server, cloud storage devices, cloud usage monitor, resource replication, readymade environment	8
3	**Cloud Programming:** Programming Support for Amazon EC2: Amazon S3, EBS and Simple DB Programming Support for Google Apps engine: GFS, Big 4 Tables, Googles NO SQL System, Chubby, Google Distributed Lock Service	7

4	**Cloud Security:** Securing the Cloud, The security boundary, Security service boundary, Security mapping. Host security for SaaS, 4 PaaS and IaaS, **Data Security:** Data Security Concerns, Data Confidentiality and Encryption, Data Availability, Data Integrity, Cloud Storage Gateways, Cloud Firewall **Establishing Identity and Presence: Identity and Access Management (IAM)**	8
5	**Serverless Computing:** overview of serverless computing, serverless architecture and design patterns, Microservices and event-driven architectures, Functions and triggers Serverless Platforms and Providers: Overview of serverless platforms and providers (AWS Lambda, Google Cloud Functions, Azure Functions, etc.) Features and capabilities of serverless platforms, Overview of serverless security and governance	6
6	**Cloud Applications:** MapReduce: Paradigm, Programming Model, Applications, Scheduling, Fault-Tolerance, Implementation Overview, Examples Introduction to Spark: Resilient Distributed Datasets (RDDs), RDD Operations, Spark applications: Page Rank Algorithm, GraphX, GraphX API, GraphX working **Introduction to Kafka**: Kafka, Use cases for Kafka, Data model, Architecture, Types of messaging systems, Importance of brokers, Kafka Stream processing	6

Text Book:

1. "Cloud Computing Bible" by Barrie Sosinsky (2018)
2. "Cloud Computing" by Mehul Mahrishi Kamal Kant Hiran, Ruchi Doshi, Dr. Fagbola Temitayo.(2019)
3. Cloud Computing: Methodology, Systems, and Applications by Lizhe Wang, Rajiv Ranjan, Jinjun Chen, and Boualem Benatallah were released by CRC Press in 2017.
4. Cloud Computing: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti 2014.

Reference books:

1. Judith Hurwitz ,"Cloud Computing for Dummies" , Wiley Publication.(2020)
2. "Cloud Security and Privacy: An Enterprise Perspective on Risk and Compliance" by Tim Mather, Subra Kumaraswamy, Shahed Latif.(2019)
3. "Cloud Computing: Concepts, Technology & Architecture", Thomas Erl Ricardo Puttini, Zaigham Mahmood, 2013
4. "Cloudonomics: The Business Value of Cloud Computing", Joe Weinman, 2012

Useful Links:

1. https://www.coursera.org/learn/introduction-to-cloud
2. https://www.coursera.org/projects/googlecloud-introduction-to-cloud-dataproc- hadoop-and-spark-on-google-clou-j3jfl
3. https://www.coursera.org/learn/ibm-cloud-essentials
4. https://www.coursera.org/learn/microsoft-azure-cloud-services

Suggested List of Experiments:

Cloud Computing Laboratory (DJS22AML604)	
Sr. No.	**Name of Experiment**
1	Virtualization: Hosted Virtualization and Bare Metal Virtualization
2	Creating a virtual machine on a public cloud platform: how to create a virtual machine on a public cloud platform like Amazon Web Services (AWS) or Microsoft Azure and configure it to run a basic application.
3	Host a Static Website on cloud.
4	Configure Identity and Access Management (IAM) for secure access.
5	Create and migrate relational database on cloud.
6	Study different Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS) application.
7	Install Google App Engine. Create simple web applications using python/java
8	Building a simple web application on the cloud: how to build a simple web page using the cloud infrastructure mechanism, including a virtual server, cloud storage, and networking services.
9	Automate Infrastructure Development using IaaS.
10	Implement serverless architecture and configure notification services.
11	Cloud case studies and future trends Case studies of successful cloud deployments in AI/ML Emerging cloud technologies and trends Ethical and legal considerations in cloud computing

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.

Prepared by   Checked by   Head of the Department   Vice-Principal   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: IoT Foundations (DJS22AMC6011)		
Course: IoT Foundations Laboratory (DJS22AML6011)		

Course Objectives:

1. To introduce basic architecture and organization of processor and controller.
2. To introduce optimizing techniques for machine learning.
3. To introduce different architectures used for connected smart devices.
4. To study integration of AI with IoT and various protocols used in the IoT environment.

Outcomes: Students will be able to

1. Understand the basic architecture and organization of processor and controller.
2. Discover embedded systems design principles and concepts.
3. Appraise the role of IoT protocols for efficient network communication.
4. Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

IoT Foundations (DJS22AMC6011)		
Unit	**Description**	**Duration**
1	**Introduction to Microprocessor and Microcontroller** Architecture of Microprocessor 8086-Internal registers, CPU, ALU, Types of System Bus, Bus Structure- address and data bus, Instruction Register, Timing and Control, Interrupts and Serial I/O. Microcontroller: CPU architecture, memory organization, and I/O ports, Embedded peripherals (timers, counters, ADC, DAC), Interrupt handling and real-time programming.	8
2	**Embedded systems design principles and concepts** Design Principles for Embedded Systems, Techniques for optimizing ML algorithms for low-power devices, Quantization, pruning, and model compression, Model selection and trade-offs in resource-constrained environments.	4
3	**Introduction to IoT** Definition, Characteristics, Physical and 8 Logical Designs, IoT Protocols, IoT Communications Models and API, IoT Enabling Technologies, IoT Levels and Deployment Templates, IoT Examples, M2M, Industrial IoT (IIoT) and architecture. RFID Technology – Working of RFID, Components of an RFID system, RFID Transponder (tag) classes, System architecture, Localization and Handover Management, Technology considerations, Performance Evaluation, Applications.	8

4	**IoT Data Collection and Preprocessing** Sensor networks and data acquisition techniques - Data Preprocessing for AI and machine learning, Edge Computing for Machine Learning - Deploying machine learning models on edge devices - Edge analytic and decision-making algorithms.	6
5	**IoT and AI Integration** AI –Graphic Processing Unit, Tensor Processing Unit, FPGA-based acceleration for machine learning, case study on Google's TPU and the Edge TPU. TensorFlow Lite, ONNX Runtime, and Edge TPU for deployment of AI models.	8
6	**IoT applications** IoT for Entertainment and wearables, IoT for Manufacturing, IoT for Employee safety, IoT for healthcare, IoT for Logistics & Supply chain, Retail Supply chain control, NFC Payment, Intelligent shopping application, Smart product management. Case studies on Smart cities, Smart Home, Smart Environment, Smart Agriculture.	5
	Total	39

Books Recommended:

Textbooks:

1. Design Principles for Embedded Systems, KCS Murti, Springer Singapore ISBN-978-981-16-3295-2, 22 September 2022.
2. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018.
3. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017.
4. Hakima Chaouchi, "Internet of Things: Connecting Objects to the Web", 1st Edition, Wiley, 2013.

Reference Books:

1. Intelligent Connectivity: AI, IoT, and 5G (IEEE Press), Abdulrahman Yarali Wiley-IEEE Press, 2021.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems–Real Time Interfacing", Publisher Cengage Learning, 3rd Edition, 2012.
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 2015.

Web Links

1. NPTEL :: Computer Science and Engineering - Microprocessors and Microcontrollers
2. Embedded Systems Academy- https://www.embedded-sys.com/plus/
3. Embedded Systems Basics by Tutorials point-https://www.tutorialspoint.com/embedded_systems/index.htm

Suggested List of Experiments

Sr. No.	Title of the Experiment
IoT Foundation (DJS22AML6011)	
1	Setting Up and Programming the Arduino.
2	Implement basic operations for the MQTT protocol: publish and subscribe
3	Use the NodeMCU to subscribe to messages that published by MQTT client, then display these messages on a 1602 I2C LCD display.
4	To study and implement interfacing of different IoT sensors with Raspberry Pi pico/Arduino/ModeMCU.
5	To study and implement interfacing of actuators based on the data collected using IoT sensors. (like led switch ON/OFF, stepper motor)
6	To study and implement IoT Data processing using Pandas
7	3D Pong Game With Arduino and vPython
8	Understanding and Creating a Simple Client Server Configuration

Prepared by   Checked by   Head of Department   Vice-Principal   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: Time Series Analysis(DJS22AMC6012)		
Course: Time Series Analysis Laboratory (DJS22AML6012)		

Objectives:

1. Learn basic analysis of time series data.
2. Auto regressive and model averaging models.
3. Learn basic concepts of forecasting.
4. To understand the detection of outliers in time series data.

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

1. To understand the basics of Time series Analysis.
2. To apply statistical smoothening methods for the time series data
3. To forecast the time series data using traditional methods
4. To analyze and explore the deep learning techniques for forecasting the time series data

Time Series Analysis(DJS22AMC6012)		
Unit	**Description**	**Duration**
1	**Introduction to Time series:** Taxonomy of time series forecasting methods, Time series Decomposition. Real-life examples of time series, types of variation in time series, tests of randomness, tests for trend, seasonality.	5
2	**Exploratory Data Analysis & Visualizations for Time Series Analysis:** Handling time series data: working with Date and Time, Handling Missing values: Understanding missing data, performing data quality checks, handling missing data with univariate imputation using pandas and scikit-learn, Plotting Time series data with interactive Visualizations using hvPlot, Decomposing Time series data.	8
3	**Smoothening Methods:** Naïve method, Seasonal Naïve method, Average method, Moving Average Smoothing, Time series analysis using Linear Regression, Autocorrelation, Auto Regression, stationary data, differentiation, Seasonal differentiation, moving average of error, ARIMA Model, SARIMA, Machine Learning methods- windowing, Neural Network Auto Regressive	8
4	**Forecasting:** Forecasting in time series models, forecasting for autoregressive processes, One-step ahead predictors based on the	6

	finite past: Durbin-Levinson algorithm.	
5	**Deep Learning for Time Series Forecasting:** Understanding Artificial Neural Networks, forecasting with an RNN using keras, forecasting with LSTM with keras, forecasting with a GRU using keras , forecasting with an RNN using PyTorch, Forecasting with an LSTM using PyTorch, Forecasting with GRU using PyTorch	6
6	**Outlier Detection in Time series Data:** Detecting Outliers using Statistical methods: Visualizations, Tukey method, z-score and modified z- score. Detecting Outliers using Unsupervised Machine Learning Techniques: KNN, LOF, iForest, One-class Support Vector Machine (OCSVM), Detecting outliers using COPOD and PyCaret.	6
	Total	39

Books Recommended:

Text Books:

1. Tarek A. Atwan, "Time Series Analysis with Python Cookbook: Practical recipes for exploratory data analysis, data preparation, forecasting, and model evaluation", Packt Publishing Limited, 2022.
2. James D. Hamilton, "TIME SERIES ANALYSIS" ,Levant Books, 2012.
3. B. V. Vishwas and Ashish Patel, "Hands-on Time Series Analysis with Python," First Edition, Apress, 2020.
4. Ted Dunning and Ellen Friedman," Time Series Databases: New Ways to Store and Access Data", First Edition, O'Reilly, 2019.

Reference Books:

1. Vijay Kotu , Bala Deshpande , "Data Science: Concepts and Practice", Second Edition, Morgan Kaufmann, 2018.
2. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications : With R Examples," Springer, 4th Edition, 2017.

Web Links:

1. Energy consumption time series forecasting with python and LSTM deep learning model | by Eligijus Bujokas | Towards Data Science
2. Autoregression Models for Time Series Forecasting With Python - MachineLearningMastery.com
3. Python | ARIMA Model for Time Series Forecasting - GeeksforGeeks
4. Weekly Rainfall and Temperature Forecasting | Kaggle

5. Air Passenger Forecast : ARIMA - SARIMA | Kaggle
6. Stock Price prediction by simple RNN and LSTM | Kaggle
7. LSTM for Time Series Prediction in PyTorch - MachineLearningMastery.com
8. Gated Recurrent Unit (GRU) With PyTorch (floydhub.com)

Suggested List of Experiments:

S No	Name of Experiment
Time Series Analysis Laboratory(DJS22AML6012)	
1	Data Preprocessing: Clean and preprocess a given time series dataset, handling missing values.
2	Data Exploration: Use Pandas to explore and visualize various time series datasets.
3	Autoregression Models for Time Series Forecasting with Python
4	Apply ARIMA - SARIMA models to predict / forecast the number of passengers travelling using aeroplanes based on time series data.
5	Implementing Basic RNN: Develop an RNN model for stock price prediction using historical data.
6	Time Series Prediction with LSTM Recurrent Neural Networks in Python with Keras
7	Gated Recurrent Unit (GRU) With PyTorch
8	Outlier Detection using statistical methods.
9	Outlier Detection using Unsupervised Machine Learning Techniques
10	Compare and contrast on Statistical methods and Deep Learning methods by forecasting the Weekly Rainfall and Temperature.

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

Prepared by   Checked by   Head of Department   Vice-Principal   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI

Course: Human Machine Interaction (DJS22AMC6013)

Course: Human Machine Interaction Laboratory (DJS22AML6013)

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, learner will be able to:

1. Identify the various design principles used for interacting between human and machine.
2. Apply human psychology of everyday actions and UI design processes for real world applications.
3. Implement mobile, windows, and web-based application
4. Evaluate and justify UI design and Create an application for a social and technical task.

Course: Human Machine Interaction (DJS22AMC6013)		
Unit	**Description**	**Duration**
1	**Introduction:** Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields. The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error.	07
2	**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 popularity, characteristics. Principles of user interface design.	06
3	**Understanding Goal-Directed Design:**	07

	Goal-directed design; Implementation models and mental models; Beginners, experts, and intermediates – designing for different experience levels. Understanding users; Modeling users – personas and goals.	
4	**Design Guidelines:** perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, and time.	07
5	**Interaction Styles and Communication:** **Interaction Styles:** Menus, Windows, Device-based and Screen-based Controls. **Communication:** Text messages, Feedback, and Guidance, Icons, Multimedia, and colors.	07
6	**UX tools**: Figma, Just In Mind, and any open-source tool for prototype designing. Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.	05
	Total	39

Books Recommended:

Text Books:
1. Kalbande,Kanade,Iyer, "Galitz's Human Machine Interaction", 1st Edition, Wiley Publications, 2015.
2. Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale, "Human Computer Interaction", Peason,Prentice Hall, 3rd Edition, 2003
3. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication, 3rd Edition, 2007.
4. Donald A. Normann," Design of everyday things", Basic Books; 2nd Edition, 2013

Reference Books:
1. Rogers Sharp Preece, "Interaction Design: Beyond Human Computer Interaction", 5th Edition, Wiley publications.
2. Brian Fling, "Mobile Design and Development", 1st Edition, O'Reilly Media Inc.,2009.

Web links
1. Nielsen's Heuristics: 10 Usability Principles To Improve UI Design - Aela School
2. 12 UX Designer Tools You Should Be Using (From Beginner to Pro) | Columbia Engineering Boot Camps

Human Machine Interaction Laboratory (DJS22AML6013)	
Sr. No.	**Title of the Experiment**
1	To Study of open-source UX tools (Justinmind Prototype, Pidoco, Marvel ,Figma Prototype) and create a simple design for a given problem definition.
2	**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?
3	**Goal-oriented design** - Design an experience for passengers whose flight /train is delayed.
4	**Design Principles** - Understand principles of good UI design by heuristic evaluation. Design UI for a given problem statement.
5	**Menus & Navigation** – Redesign of a user interface (Suggest and implement changes in Existing User Interface) for a given problem statement.
6	a. **Windows & Screen controls** – Design UI for a given problem statement.Design a navigator for a student new in your Institute. b. Design a navigator for a person new in tourist city/ village. c. Motor paralysis for differently able people. d. 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
	To calculate the screen complexity of the existing Graphical User Interface and redesign the interface to minimize the screen complexity.

Prepared by   Checked by   Head of Department   Vice-Principal   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: Professional and Business Communication Laboratory (DJS22IHL2)		

Pre-requisite:

Basic course in Effective Communication Skills

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. Prepare technical documents using appropriate style, format, and language
2. Use employability skills to optimize career opportunities
3. Employ storytelling techniques in corporate situations
4. Conduct effective meetings and document the process
5. Demonstrate interpersonal skills in professional and personal situations
6. Describe cultural differences, etiquettes, and the concept of professional ethics

Professional and Business Communication Laboratory (DJS22IHL2)		
Unit	**Description**	**Duration**
1	**Unit 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	**Unit 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	**Unit 3 : Corporate Story Telling:** **Basics of storytelling:** Setting, characters, plot, crisis, climax, resolution, Benefits of storytelling **Types of stories:** Elevator pitch, product stories, event stories, stories in presentations, storytelling in SOP's and interviews, storytelling to manage conflict or to motivate **Storytelling techniques:** Narration using verbal and non-verbal communication, Analysis of storytelling strategies of corporate master storytellers	03
4	**Unit 4: Meetings and Documentation:** **Planning and preparation for meetings:** Planning layout of meetings, arranginglogistics, 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	**Unit 5: Introduction to Interpersonal Skills** **Emotional Intelligence:** Definition, difference between IQ and EQ, how todevelop 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, time wasters, setting priorities and goals, **Conflict Management:** Types of conflicts, strategies to manage conflict, case studies	05
6	**Unit 6: Cross-cultural communication and Professional ethics** **Communication across cultures**: Understanding cultures and developingsensitivity towards cultural differences **Corporate etiquettes**: Telephone, dining, cubicle etiquette, etc. **Professional ethics**: Effective work habits, accountability, integrity and excellence	02
	Total	39

Books Recommended:

Text 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

Reference Books:

1. Heta Murphy*, "Effective Business Communication",* Mc Graw Hill, edition

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

Prepared by   Checked by   Head of Department   Vice-Principal   Principal

Program: Artificial Intelligence & Machine Learning	T.Y. B.Tech.	Semester: VI
Course: Innovative Product Development IV		

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 conceptualise 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 theteam or as theleader.
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 tothe 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 committee10

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;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. 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 VI.

Prepared by   Checked by   Head of Department   Vice-Principal   Principal