Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAIE301	**Computer Vision**	ELECTIVE	2	2

Course Outcome:

1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand Hough Transform and its applications to detect lines, circles, ellipses.
4. To understand three-dimensional image analysis techniques.
5. To understand motion analysis. To study some applications of computer vision algorithms.

Learning Outcome:

1. Implement fundamental image processing techniques required for computer vision.
2. Perform shape analysis.
3. Implement boundary tracking techniques.
4. Apply Hough Transform for line, circle, and ellipse detections.
5. Apply 3D vision techniques.
6. Implement motion related techniques.
7. Develop applications using computer vision techniques.

UNIT	TOPICS
UNIT - I	**Introduction:** What is computer vision?, A brief history, Image formation, Geometric primitives and transformations, 2D transformations, 3D transformations, 3D rotations, 2D to 3D projections, Lens distortions, Photometric image formation, Lighting, Reflectance and shading, Optics, The digital camera, Sampling and aliasing, Colour ,Compression
UNIT - II	**Image Processing:** Point operators, Linear filtering, More neighbourhood operators, Fourier transformation, **Feature detection:** edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors, Morphological operations,Object recognition, R-CNN, YOLO.
UNIT III	**Segmentation:** Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, normalized cut. **Recognition :** Object detection, face recognition, Instance recognition, VGGFace2, FaceNet.
UNIT IV	**Deep Learning Networks :**

	Convolutional Neural Network, CCN Architecture,LeNet Architecture, AlexNet Architecture, DeconvNet Architecture, VGGNet, SegNet Architecture.

References:

1. Computer Vision: Algorithms and Applications, R. Szeliski, Springer, 2011.
2. Introductory techniques for 3D computer vision, E. Trucco and A. Verri, Prentice Hall, 1998
3. Computer Vision: Principles, Algorithms, Applications, Learning, E. R. Davies

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAIE301P	**Computer Vision**	ELECTIVE	2	2

Practical List:

1. Windows and Plots
2. Program to change the Brightness of Image
3. To Flip the image around the vertical and horizontal line
4. Display the color components of the image
5. Red Green Blue Components of Image
6. To find the negative of an image
7. Calculate the Histogram of a given image
8. Histogram Equalization of an image
9. Program for Image Filtering(low pass filter)

1)Average filter
2)Weighted Average filter
3)Median filter

10. High pass filters using

1)Sobel operator
2) Laplacian operator

11. Edge detection with gradient and convolution of an Image
12. Program to find threshold of grayscale image
13. Program to find threshold of RGB image
14. Program to estimate and subtract the background of an image
15. Program to convert color image to gray and hsv

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAIE302	**Natural Language Processing**	ELECTIVE	2	2

Course Objectives:

1. To learn sentence structure.
2. To learn Morphological analysis, Lexical analysis, Syntactic and Semantic analysis.
3. To learn feature engineering concepts and rule-based systems for NLP.
4. Using Machine learning and deep learning for NLP.

Learning Outcomes:

Upon completion of this course, the student should be able to

1. Analyse corpus and corpora of NL.
2. Learn language modeling, formal grammars, statistical parsing, machine translation, and dialog processing.
3. Understanding statistical sequence labeling, information extraction, question answering and summarization, advanced topics in speech recognition, speech synthesis.

UNIT	TOPICS
UNIT - I	**Introduction:** What is copus and its types, Components of NLP, Regular expressions, Coporpora, Word Tokenization, Stemming & Lemmatizing, Sentence Segmentation and Minimum Edit Distance. **Text Representation:** OneHotEncoder for Textual data, Bag of Words, Ngram, Bi-Gram and Trigrams, TFIDF, Word2Vec.
UNIT - II	**Naive Bayes, Text Classification, and Sentiment:** Naive Bayes Classifiers, Training the Naive Bayes Classifier, Optimizing for Sentiment Analysis, Naive Bayes as a Language Model, Evaluation: Precision, Recall, F-measure.
UNIT - III	**Hidden Markov Models and Speech Recognition:** Speech Recognition Architecture, Overview of Hidden Markov Models, The Viterbi Algorithm Revisited, Advanced Methods for Decoding, Acoustic Processing of Speech, Computing Acoustic Probabilities, Training a Speech Recognizer, Waveform Generation for Speech Synthesis, Human Speech Recognition , Word Classes and Part-of-Speech Tagging: Tagsets for English, Part of Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging.
UNIT - IV	**Transformers and Large Language Models**

	The Transformer: A Self-Attention Network, Multihead Attention, Transformer Blocks, The Residual Stream view of the Transformer Block, The Language Modelling Head, Large Language Models with Transformers, Large Language Models: Training Transformers

Reference Books:

1. Daniel Jurafsky and James Martin Speech and Language Processing (2nd Edition), Prentice Hall:2 edition,2008.
2. "Python Natural Language Processing", Jalaj Thanaki, Packt.
3. "Natural Language Processing with Python: Analyzing Text with the Natural Launguage Toolkit", By Steven Bird, Ewan Klein, and Edward Loper, NLTK.
4. "Speech and Language Processing", Daniel Jurafskey and James H. Martin, Prentice Hall, 2009.

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAIE302P	**Natural Language Processing**	ELECTIVE	3	3

Practical

1. Web Scraping: Scrape data from a webpage & store it into csv format.
2. Implementation of Sentimental Analysis
3. Implementation of Text Preprocessing
4. Demonstrate the Parser in NLP
5. Perform Feature Extraction technique in NLP task
6. One Hot Encoding
7. Bag-Of-Words(BOW)
8. N-Grams
9. Term Frequency Inverse Document Frequency
10. Demonstrate the working of Word Embedding in Natural Language Processing

Course Code	Course Name	Group	Teaching Scheme
			Lectures
RJSPGDSAI402	**Machine Learning System Design**	ELECTIVE	2

Course Outcome:

1. To understand how to Design, Deploy and Monitor Systems using Machine Algorithms.
2. To understand Time Series Forecasting and Graph Neural Network.
3. To understand ML Infrastructure and its Platform.

Learning Outcome:

1. Develop an appreciation for what is involved in Learning models from data
2. Understand a wide variety of learning algorithms
3. Understand how to evaluate models generated from data
4. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

UNIT	TOPICS
UNIT - I	Understanding machine learning production, ML and Data Systems Fundamentals, Training Data, Feature engineering, Model selection, development, and training
UNIT - II	Model evaluation, Deployment, Diagnosis of ML system failures & data distribution shifts & monitoring, Monitoring & Continual Learning
UNIT - III	Model Deployment, Experiment tracking & versioning with Weights & Biases
Unit IV	Deploying time series forecasting and graph neural networks, ML Infrastructure and Platform

References:

1. Designing Machine Learning Systems by Chip Huyen Released May 2022 Publisher(s): O'Reilly Media, Inc.
2. Machine Learning System Design With end-to-end examples by Valerii Babushkin and Arseny Kravchenko, MEAP began April 2023

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI402P	**Machine Learning System Design**	ELECTIVE	4	2

Practicals:

1. Design a hotel booking chatbot.
2. Design a podcast search engine.
3. Design a personalized Uber.
4. Design type-ahead search for Stack Overflow.
5. Design autocomplete for text messages.
6. Build a dynamic pricing system.
7. Predict user behavior changes after product updates.
8. Design a framework for evaluating ad rankings.
9. Design a personalized newsfeed.
10. Design an image classifier.
11. Design a sentiment analysis model.

Course Code	Course Name	Group	Teaching Scheme
			Lectures
RJSPGDSAIE402	**Cloud Native Development**	ELECTIVE	2

Course Outcome:

1. The evolution of cloud-native computing and security.
2. How to secure cloud and cloud-native applications.
3. To understand Automation and DevOps.
4. To understand Docker and CI/CD pipelines
5. DevSecOps and the future of security.

Learning Outcome:

1. Explain cloud-native architectures and discuss benefits for using this approach to a range of audiences.
2. Review cloud-native application designs and implementations, and propose strategies to improve their performance.
3. Able to create Docker Images
4. Understands Microservices and Monolithic Application.

UNIT I	**Cloud-Native Development:** What Is Cloud-Native? Traditional Development vs. Cloud-Native, Agile Practices - Feature-Driven Development, Value-Driven Development, Agile Teams, Writing User Stories, Activity: Analyzing the Case Study Requirements **Automation and DevOps:** Infrastructure as Code (IaC), Continuous Integration and Continuous Delivery (CI/CD)
UNIT II	**Microservices: Introduction to Microservices -** Monolithic vs. Microservice Applications, Recognizing Microservice Boundaries, Stateful vs. Stateless Services, Managing Databases, Activity: Architecting Microservice Applications. **Twelve-Factor Apps -** The Twelve Factors, Implementing Twelve-Factor Apps. **Microservice Architecture -** Designing Loosely-Coupled Services, Communicating Between Microservices, REST, gRPC, OpenAPI, Activity: Running the Case Study
UNIT III	**Docker: Understanding Docker -** Containers, Advantages of Containers, Images. **Using Docker -** Basic Docker Commands, Building Docker Images, Dockerfile, Starting Containers, Stopping Containers, Deleting Containers and Images, Activity: Containerizing the Case Study. **Deploying Docker Containers:** Container Registries, Push and Pull, Activity: Managing Docker Containers in a Container Registry

UNIT IV	**CI/CD Pipelines -** Cloud-Based (Azure, AWS, Google Cloud) CI/CD Tools, Kubernetes Jenkins, Spinnaker, Terraform, GitHub Actions, Activity: Building a CI Pipeline

References

1. Boris Scholl, Trent Swanson, Peter Jausovec " Cloud Native " , O'Reilly Media, Inc., 2019
2. Michael Wittig and Andreas Wittig " Cloud Native Applications", MANNING, 2016
3. Matthew A. Titmus "Cloud Native Go ", O'Reilly Media, Inc., 2021

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAIE402P	**Cloud Native Development**	ELECTIVE	4	2

Practical List:

1. Perform basic commands of Docker.
2. Perform Dockerfile Commands
3. Perform Docker Compose Commands
4. Perform Docker Networking
5. Perform Docker Volumes
6. Perform Docker Object Commands
7. Perform Docker Advanced Commands
    a. docker history image
    b. docker save image > file
    c. docker load < file
    d. docker commit container image
8. Perform Docker System Commands
    a. docker info
    b. docker version
    c. docker system df
    d. docker system events
    e. docker system prune
9. Perform Docker Swarm Commands
10. Perform Container Orchestration with Docker Swarm