छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI MAHRAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

For

Metric No. – 1.1.1

Programme Outcomes & Course Outcomes

Under the

Criteria - I

(Curriculum Design and Development)

Key Indicator - 1.1

In

Metric No. – 1.1.1

Co-ordinator
Internal Quality Assurance Cell
CSJM University, Kanpur

(Registrar)
C.S.J.M.University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY

KANPUR

SYLLABUS

(PG Diploma in Data Science and Machine Learning)

INFORMATION TECHNOLOGY

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF INFORMATION TECHNOLOGY

U.I.E.T., C.S.J.M.UNIVERSITY, KANPUR

POST GRADUATE DIPLOMA IN DATA SCIENCE AND MACHINE LEARNING

Vision

To achieve excellence in engineering education, empower students to be technically competent professionals and entrepreneurs with strong ethical values so as to significantly contribute as agents for universal development and societal transformation

Mission

To provide affordable quality education at par with global standards of academia and serve society with harmonious social diversity

To encourage new ideas and inculcate an entrepreneurial attitude amongst the students, and provide a robust research ecosystem

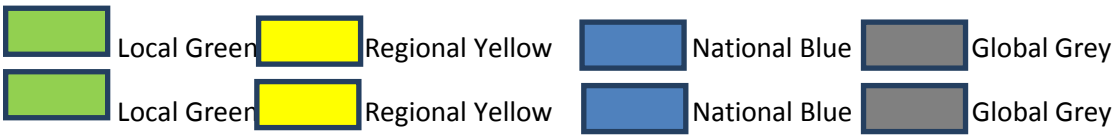
To practice and encourage high standards of professional ethics and accountability among students

POST GRADUATE DIPLOMA IN

DATA SCIENCE AND MACHINE LEARNING

Program Outcomes (POs)

PO1	**Engineering knowledge:** Acquire strong fundamental knowledge of computer science and engineering along with mathematics.
PO2	**Problem analysis:** Ability to identify, formulate &analyse requirements of a problem to provide sustainable solution which are in coherence with the local/regional/national or global needs and feasibility
PO3	**Design/development of solutions:** Design solution for complex problems, which incorporate components and processes, which are sustainable and reusable.
PO4	**Conduct investigation of complex problems:** Develop skills to synthesize research-based knowledge in the design, interpretation, analysis and synthesis of data for providing solutions to complex problems
PO5	**Modern tool usage:** Possess programming skills in different contemporary programming languages and use different development tools. Be able to select the appropriate tool/programing language/platform and understand the limitations of the same while implementing the solution.
PO6	**The Engineer and Society:** To apply skills for social causes at the local, regional, national and global level and work towards sustainable solutions. Apply reasoning informed by the contextual knowledge to access social, legal and cultural issues.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environment contexts
PO8	**Ethics:** To understand contemporary legal, social & ethical issues in computing.
PO9	**Individual and Teamwork:** Posses Flexibility to adapt to a team environment. To be able to work as an individual or as a member or a team leader in multidisciplinary team organizations.
PO10	**Communication:** To be able to present and communicate precisely and effectively. Be able to comprehend and write effective reports and design documents and presentations professionally and be able to perceive and give clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply to work in the capacity of a member/leader in the team to manage projects
PO12	**Life-long learning:** To have passion for acquiring technical advancements in the field of computer science and engineering and apply new technology for solving local/regional/national or global problems



Program Specific Outcomes (PSOs)

PSO-1	To be able to understand problem, think of best suitable approach to solve the problem, develop and evaluate effective solutions as per the local/regional/ national/ global requirements and availability of resources/ technologies.
PSO-2	To be able excel in contemporary technologies being adopted by the industry and academia for providing sustainable solutions
PSO-3	To be able to excel in various programming/project competitions and technological challenges laid by professional bodies

Program Educational Outcomes (PEOs)

PEO-1	To make the students ready for successful career leading to higher education/ industry and to apply expertise in solving global problems.
PEO-2	To empower students achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments.
PEO-3	To encourage students maintain and improve their technical competence through lifelong learning.

Semester: I

QP CODE	PAPER NAME	PAPER TYPE	INTERNAL MARKS	EXTERNAL MARKS	COMPULSORY/ OPTIONAL
PGDDS-1001	INTRODUCTION TO DATA SCIENCE	TH	25	75	C
PGDDS-1002	MATHEMATICS FOR DATA SCIENCE & MACHINE LEARNING	TH	25	75	C
PGDDS-1004	INTRODUCTION TO STATISTICS	TH	25	75	C
PGDDS-1005	DATA ANALYSIS AND VISULIZATION	TH	25	75	C
PGDDS-1006	MACHINE LEARNING	TH	25	75	C
PGDDS-1007	INTRODUCTION TO DATA SCIENCE (PYTHON LAB)	PL	30	20	C
PGDDS-1008	PYTHON FOR DATA SCIENCE	PL	60	40	C
PGDDS-1009	DATA ANALYSIS AND VISULIZATION	PL	30	20	C
PGDDS-1010	MACHINE LEARNING	PL	30	20	C

Semester: II

QP CODE	PAPER NAME	PAPER TYPE	INTERNAL MARKS	EXTERNAL MARKS	COMPULSORY/ OPTIONAL
PGDDS-2001	TEXT ANALYTICS	TH	25	75	C
PGDDS-2002	ADVANCE MACHINE LEARNING	TH	25	75	C
PGDDS-2005	NEURAL NETWORKS	TH	25	75	C
	Elective	TH	25	75	E
PGDDS2010	TEXT ANALYTICS	PL	30	20	C
PGDDS-2011	TENSOR FLOW	PL	60	40	C
PGDDS-2012	ADVANCE MACHINE LEARNING	PL	30	20	C
PGDDS-2013	NEURAL NETWORKS	PL	30	20	C
	Elective	PL	30	20	E
PGDDS-2015	CAPSTONE PROJECT	PL	60	40	C
PGDDS-2016	SUMMER TRAINING	PL	60	40	C

List of Elective Subjects:

QP CODE	PAPER NAME	PAPER TYPE	INTERNAL MARKS	EXTERNAL MARKS	COMPULSORY /OPTIONAL
PGDDS-2017	COMPUTER VISION AND IMAGE RECOGNITION	TH	25	75	E
PGDDS-2018	COMPUTER VISION AND IMAGE RECOGNITION	PL	30	20	E
PGDDS-2019	SPEECH RECOGNITION	TH	25	75	E
PGDDS-2020	SPEECH RECOGNITION	PL	30	20	E
PGDDS-2009	DATA ENGINEERING	TH	25	75	E
PGDDS-2014	DATA ENGINEERING	PL	30	20	E

* TH THEORY

*PL PRACTICAL

Detailed Syllabus

Course Name: Introduction to Data Science and (3-0-4-6)

Course Code: PGDDS-1001

Course Objective:

- Understand basic mathematical tools required for engineering.
- Apply mathematical concepts to research problems in engineering.
- Model engineering systems mathematically.
- Analyze a mathematical model and deduce physical interpretations.

Course Outcome:

- CO1: Apply mathematical principles to the analysis of data
- CO2: Analyze very large data sets in the context of real world problems CO3: explain the concepts of base and dimension of vector space
- CO4: explain matrix representation of a linear transformation.
- CO 5: explain concepts of inner product on vector spaces.

Topics Covered:

- Emerging Technologies on AI
- Understanding Data Science and AI
- Fundamentals of Programming
- Foundations of Statistics

Textbooks and References:

1. "Data Science for Business" by Foster Provost and Tom Fawcett, published by O'Reilly Media, second edition, 2019.
2. "Python for Data Analysis" by Wes McKinney, published by O'Reilly Media, second edition, 2017.
3. "Data Science from Scratch: First Principles with Python" by Joel Grus, published by O'Reilly Media, second edition, 2019.
4. "An Introduction to Statistical Learning: with Applications in R" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, published by Springer, second edition, 2021.

Course Name: Mathematics for Data Science

Course Code: (PGDDS-1002) (3-1-0-4)

Course Objective:

- Understand basic mathematical tools required for engineering.
- Apply mathematical concepts to research problems in engineering.
- Model engineering systems mathematically.
- Analyze a mathematical model and deduce physical interpretations.

Course Outcome:

- CO1: Apply mathematical principles to the analysis of data.
- CO2: Analyze very large data sets in the context of real world problems CO3: explain the concepts of base and dimension of vector space.
- CO4: explain matrix representation of a linear transformation. CO 5: explain concepts of inner product on vector spaces.

Topics Covered:

- Linear Algebra
- Calculus
- Numerical Optimization

Textbooks and References:

1. "Linear Algebra and Its Applications" by Gilbert Strang, published by Brooks/Cole, fifth edition, 2016.
2. "Probability and Statistics for Data Science: Math + R + Data" by Norman Matloff, published by Leanpub, 2017.
3. "Mathematics for Machine Learning" by Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, published by Cambridge University Press, 2020.
4. "Calculus: Early Transcendentals" by James Stewart, published by Cengage Learning, eighth edition, 2015.

Course Name: Introduction to Statistics

Course Code: (PGDDS- 1004) (3-1-0-4)

Course objective:

To impart knowledge on Statistical concepts like Data Collection, Measures of Central Tendency and Dispersion, Probability and Distributions, Statistical Methods, Inference, Sampling methods, Experimental Designs, Economical and Vital Statistics, SQC, reliability and Operations Research.

Course Outcome: At the end of the course, students will be able to:

- CO1: Understand to have the basic knowledge on data collection and various statistical elementary tools.
- CO2: Made a bridge between the elementary statistical tools and probability theory.
- CO3:Apply the theoretical discrete probability distributions like binomial, Poisson, etc., in the relevant application areas
- CO4: Understand critically the problems that are faced in testing of a hypothesis with reference to the errors in decision making.
- CO5: Apply simple linear regression model to real life examples. Understand multiple linear regression models with applications and concept of Multicollinearity and autocorrelation

Topics Covered:

- Descriptive Statistics
- Foundations of Probability
- Probability Distributions
- Inferential Statistics
- Unsupervised Learning: Clustering
- Case Studies/Hands-on Practice

Textbooks and References:

1. "Statistics for Business and Economics" by Paul Newbold, William Carlson, and Betty Thorne, published by Pearson, ninth edition, 2019.
2. "Statistics: The Art and Science of Learning from Data" by Alan Agresti and Christine Franklin, published by Pearson, fourth edition, 2017.
3. "Introductory Statistics" by Neil A. Weiss, published by Pearson, tenth edition, 2020.
4. "Statistical Inference" by George Casella and Roger L. Berger, published by Cengage Learning, second edition, 2001.

Course Name: Data Analysis and Visualization

Course Code: (PGDDS- 1005) (3-0-6-6)

Course objective:

- Data Analysis Techniques training course aims to provide those involved in analyzing numerical data with the understanding and practical capabilities needed to convert data into information via appropriate analysis, and then to represent these results in ways that can be readily communicated to others in the organization.

Course Outcome: At the end of the course, students will be able to:

- CO1: Ability to analyze and identify best practices to handle data science.
- CO2: Ability to identify the characteristics of datasets and apply appropriate data.
- CO3: Ability to select and implement machine learning techniques for the various.
- CO4: Ability to implement various data analytics techniques to analyze the data.
- CO5: Ability to implement various data analytics techniques to visualize the data.

Topics Covered:

- Sourcing Data from Different Sources
- Data Wrangling
- Working with SQL Primer
- Designing your Own Data for Business Problem
- Exploratory Data Analysis
- Data Visualisation using Tableau

Textbooks and References:

1. "Data Analysis with Open Source Tools" by Philipp K. Janert, published by O'Reilly Media, 2010.
2. "Python Data Science Handbook" by Jake VanderPlas, published by O'Reilly Media, 2016.
3. "Data Visualization: A Practical Introduction" by Kieran Healy, published by Princeton University Press, 2018.
4. "Data Visualization with ggplot2: The Grammar of Graphics" by Hadley Wickham, published by Springer, second edition, 2016.

 Local Green  Regional Yellow  National Blue  Global Grey

Course Name: Machine Learning

Course Code: (PGDDS- 1006) (3-0-6-6)

Course objective:

- The objective of this course is to introduce the students about the knowledge of basic concepts of machine learning systems, types of learning etc.
- To make the students able to understand, compare and select appropriate machine learning algorithm for a given problem that would help the students to solve real-world problems.
- To learn the fundamental concepts of Machine Learning model building and Evaluation.

Course Outcome: At the end of the course, students will be able to:

- CO1: Introduce machine learning and its applications.
- CO2: Develop the ability to understand, apply and implement different supervised and unsupervised learning algorithms.
- CO3: Develop the ability to understand, apply and implement machine-learning algorithm.
- CO4: Analyze the performance of various machine-learning techniques and to select appropriate features for training machine-learning algorithms.
- CO5: Able to choose machine-learning algorithms to develop application.

Topics Covered:

- Python ML Library - Scikit Learn
- Introduction to ML- Types of Learning
- Linear Regression Logistic Regression k Nearest Neighbors
- Unsupervised Learning : Clustering & Dimensionality Reduction Decision Trees
- Support Vector Machines
- Recommender System
- Hands-on Case Studies for ML

Textbooks and References:

1. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy, published by MIT Press, 2012.
2. "Pattern Recognition and Machine Learning" by Christopher M. Bishop, published by Springer, 2006.
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, published by MIT Press, 2016.
4. "Applied Predictive Modeling" by Max Kuhn and Kjell Johnson, published by Springer, 2013.

Course Name: Python for Data Science

Course Code: (PGDDS- 1008) (0-0-8-4)

Course objective:

- Getting started with Python programming for data science. Basics of Python using IDLE and also get introduce to popular data science libraries like numpy, IDLE and matplot lib.

Course Outcome: At the end of the course, students will be able to:

- CO1 Identify Python syntax and semantics and be fluent in the use of Python flow control and functions.
- CO2 Demonstrate proficiency in handling Strings and File Systems.
- CO3 Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries.
- CO4 Interpret the concepts of Object-Oriented Programming as used in Python.
- CO5 Explain exemplary applications related to Network Programming, Web Services and Databases
- in Python.

Topics Covered:

- Getting Started with Python
- Hands-on Linear Algebra with NumPy
- Hands-on Data Pre-Processing using Pandas
- Preparation of Times Stamp Intel Distribution of Python

Textbooks and References:

1. "Python for Data Analysis" by Wes McKinney, published by O'Reilly Media, second edition, 2017.
2. "Python Data Science Handbook" by Jake VanderPlas, published by O'Reilly Media, 2016.
3. "Data Science from Scratch: First Principles with Python" by Joel Grus, published by O'Reilly Media, second edition, 2019.
4. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili, published by Packt Publishing, third edition, 2019.

Course Name: Text Analytics

Course Code: (PGDDS- 2001) (3-0-6-6)

Course objective:

- Widely used in knowledge-driven organizations, text mining is the process of examining large collections of documents to discover new information or help answer specific research questions.
- Text mining identifies facts, relationships and assertions that would otherwise remain buried in the mass of textual big data
- Using text analysis, computers can find patterns to determine and extract useful information from a set of text.
- Exploiting the capabilities of text analysis software can efficiently provide educators with the ability to analyses students' answers and make better judgement on their performance

Course Outcome: At the end of the course, students will be able to:

- CO1 Describe a variety of text analysis steps, understand their interdependencies, and identify algorithms for each step
- CO2 Choose an appropriate algorithm and/or analytic tool for a variety of practical text analysis problems, such as classification or named-entity recognition
- CO3 Define the difference between sequential and non-sequential probabilistic models and generative and discriminative models, identify examples of each, and give motivations for choosing one over the other
- CO4 Perform analyses of a variety of types on actual text data by writing scripts in a programming language such as R or Python
- CO5 Apply an understanding of the ways that linguistic information is structured to the analysis of natural language texts in regional and local languages.

Topics Covered:

- Text Analytics Overview
- Sentiment Analysis on Text Data
- Naïve-Bayes Model for Sentiment Classification
- Document Summarization
- Topic Modeling
- Hands-on Practice: Text Analytics - Sentiment Analysis

Textbooks and References:

1. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper, published by O'Reilly Media, 2009.
2. "Applied Text Analysis with Python: Enabling Language-Aware Data Products with Machine Learning" by Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, and Hannah Arnson, published by O'Reilly Media, 2018.
3. "Python 3 Text Processing with NLTK 3 Cookbook" by Jacob Perkins, published by Packt Publishing, 2014.

Course Name: Advance Machine Learning

Course Code: (PGDDS- 2002) (3-0-6-6)

Course objective:

- The primary purpose of machine learning is to discover patterns in the user data and then make predictions based on these and intricate patterns for answering business questions and solving business problems.
- Machine learning helps in analyzing the data as well as identifying trends.
- Advanced machine learning looks at how to improve computing power by allowing programs to learn as they run, without additional programming

Course Outcome: At the end of the course, students will be able to:

- CO1: Present the design and evaluation of a machine learning algorithm, describing the design processes and evaluation
- CO2: Understand the variance and bias trade-off in machine learning algorithms
- CO3: Understand and analyse some machine learning algorithms and have some knowledge to further improve them
- CO4: Understand and analyse some machine learning problems and have some knowledge to adapt the existing machine learning models to different purposes
- CO 5: Understand the nature of the statistical foundations of designing or adapting learning algorithms

Topics Covered:

- Model Tuning
- Overfitting and Regularisation
- Ensemble Models
- Gradient Descent and Stochastic Gradient Descent Algorithms
- Gradient Boosting Machines
- Feature Engineering & Feature Selection Techniques
- Time Series Forecasting

Textbooks and References:

1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurélien Géron, published by O'Reilly Media, Second Edition (2019).
2. "Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2" by Sebastian Raschka and Vahid Mirjalili, published by Packt Publishing, Third Edition (2019).
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, published by MIT Press, First Edition (2016).
4. "Python Deep Learning" by Valentino Zocca, Gianmario Spacagna, and Daniel Slater, published by Packt Publishing, Second Edition (2019).

Course Name: Neural Networks

Course Code: (PGDDS- 2005) (3-0-6-6)

Course objective:

- Define what is Neural Network and model a Neuron and Express both Artificial Intelligence and Neural Network
- Analyze ANN learning, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning and Boltzmann learning
- Implement Simple perception, Perception learning algorithm, Modified Perception learning algorithm, and Adaptive linear combiner, Continuous perception, learning in continuous perception.
- Analyze the limitation of Single layer Perceptron and Develop MLP with 2 hidden layers, Develop Delta learning rule of the output layer and Multilayer feed forward neural network with continuous Perceptions

Course Outcome: At the end of the course, students will be able to:

- CO1: Model Neuron and Neural Network, and to analyze ANN learning, and its applications
- CO2: Perform Pattern Recognition, Linear classification
- CO3: Develop different single layer/multiple layer Perception learning algorithms
- CO4: Design of another class of layered networks using deep learning principles
- CO 5: Learn the concepts of principle component and SOM.

Topics Covered:

- Introduction to Perceptron
- Perceptron Training
- Deep Neural Networks Keras
- API

Textbooks and References:

1. "Python Machine Learning" by Sebastian Raschka, Vahid Mirjalili. Publisher: Packt Publishing, Second Edition, 2017.
2. "Hands-On Neural Networks with Keras" by Gulli, Antonio and Kapoor, Sujit. Publisher: Packt Publishing, First Edition, 2018.
3. "Deep Learning with Python" by Francois Chollet. Publisher: Manning Publications, First Edition, 2017.
4. "Neural Networks and Deep Learning: A Textbook" by Charu Aggarwal. Publisher: Springer, First Edition, 2018.

Course Name: Data Engineering

Course Code: (PGDDS- 2009) (3-0-6-6)

Course objective:

- The objective of this course is to introduce the students about the knowledge of basic concepts of Data Engineering systems.
- The objective of this course is to make the students able to understand, compare and select appropriate Data Analytics Tool/ Software for analysis of data of a given problem that would help the students to solve real- world problems.

Course Outcome: At the end of the course, students will be able to:

- CO1 Introduce Data Engineering and its applications.
- CO2 Data Engineering lifecycle includes architecting data platforms, designing data stores, and gathering, importing, wrangling, querying, and analyzing data.
- CO3 It also includes performance monitoring and fine-tuning to ensure systems are performing at optimal levels.
- CO4 Students learn about the data engineering lifecycle. He will also learn about security, governance, and compliance.
- CO5 Develop the ability to understand, apply and implement different types Data analysis.

Topics Covered:

- Introduction to Data Engineering & Big Data
- Working with Data Base
- Connecting 3rd Party Applications to the DBMS i.e., SQL to Python Big Data & Bigdata ecosystems
- Hive- ETL
- Hive Pig HBase
- Spark
- Big Data Cluster on Cloud
- Big Data Visualisation

Textbooks and References:

1. "Data Engineering with Python" by Paul Crickard III. Publisher: Manning Publications, First Edition, 2020.
2. "Python for Data Engineering" by Wes McKinney. Publisher: O'Reilly Media, First Edition, 2018.
3. "Practical Data Engineering" by Andreas Kretz. Publisher: Packt Publishing, First Edition, 2019.
4. "Building Data Engineering Pipelines with Python" by Paul Bilokon. Publisher: Apress, First Edition, 2020.

Course Name: Tensor Flow

Course Code: (PGDDS- 2011) (0-0-8-4)

Course objective:

- Get familiar with TensorFlow and Keras, and their capabilities
- Learn how to set up and get started with TensorFlow in the Google Colab environment
- Learn the differences between implementing a simple linear regression model in TensorFlow and in NumPy
- Get familiar with L1 and L2 regularizations and how to employ them to avoid overfitting
- Learn how to use early stopping, dropout, and batch normalization techniques to avoid overfitting

Course Outcome: At the end of the course, students will be able to:

- CO1: Review tools available to build Deep Learning including: Tensor Flow, Keras, and Theano
- CO2: Understand the GUI (Graphical User Interface) of interface software and how it interfaces with TensorFlow CO3: Review Machine Learning models that can be implemented
- CO4: Build Deep Learning Machine Learning models using TensorFlow and various interfaces
- CO 5 To solve real problem uisng Tensorflow

Topics Covered:

- TensorFlow Overview
- TensorFlow 1.X Programming Model
- Tensors
- Computational Graphs
- Sessions
- Linear Algebra with TensorFlow
- TensorFlow 2.0
- Hands-on Exercises with TF 1.x & TF2.0

Textbooks and References:

1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron. Publisher: O'Reilly Media, Second Edition, 2019.
2. "TensorFlow 2.0 in Action" by Thushan Ganegedara, published by Manning Publications, First Edition, 2020.
3. "Deep Learning with Tensorflow" by Giancarlo Zaccone. Publisher: Packt Publishing, Second Edition, 2018.
4. "Tensorflow for Deep Learning: From Linear Regression to Reinforcement Learning" by Bharath Ramsundar and Reza Bosagh Zadeh. Publisher: O'Reilly Media, First Edition, 2018.

 Local Green  Regional Yellow  National Blue  Global Grey

Course Name: Capstone Project

Course Code: (PGDDS- 2015) (0-0-8- 4)

Course objective:

- The main objective of a capstone course is to enable the students to integrate the knowledge gained as a result of pursuing a given degree program in college or university.
- The course should enable the students to integrate the skills and concepts learned systematically during their stay at the university
- Capstone projects are generally designed to encourage students to think critically, solve challenging problems, and develop skills

Course Outcome:

- CO1: Apply and synthesize theory, knowledge and skills developed during the course to plan, execute and deliver individually negotiated, supervised investigative project
- CO2: Research a real life policy or management issue; integrate student learning; and present an actionable proposal for policy makers or institutional manager
- CO3: Tackle complex tertiary education management problems; present evidence and analysis; and manage the practical elements of an investigative project that may involve clients or research participant
- CO4 Collaborate with others to accomplish communicative goals
- CO 5: Embrace difference; and Influence discourse.

Topics Covered:

- Creating a Hierarchical Classification Tool for COVID-19 Literature
- Patch Classification from Image Labels – Healthcare
- Traffic Sign Recognition

Course Name: Computer Vision and Image Recognition (3-0-6- 6)

Course objective:

- One of the popular applications of Deep Learning is in image recognition. You will learn how to build complex image recognition and object detection models and apply them to solve business use cases.

Course Outcome:

CO1: Understanding of fundamental concepts of computer vision, including image processing, feature extraction, object recognition, and machine learning techniques.

CO2: Familiarity with software tools used in computer vision, such as OpenCV, TensorFlow, and Keras.

CO3: Image acquisition and preprocessing.

CO4: Object recognition and tracking.

Topics Covered:

- Computer Vision with Open CV
- Convolutional Neural Networks (CNN)
- Pre-trained CNN Models
- Image Classification with KERAS
- Object Detection
- Hands-on Practice on Healthcare, Automobile and Retail Analytics

Textbooks and References:

1. "Computer Vision: Algorithms and Applications" by Richard Szeliski. Publisher: Springer, First Edition, 2010.
2. "Learning OpenCV 4 Computer Vision with Python 3" by Joseph Howse and Prateek Joshi. Publisher: Packt Publishing, First Edition, 2019.
3. "Hands-On Image Processing with Python" by Sandipan Dey. Publisher: Packt Publishing, First Edition, 2018.
4. "Deep Learning for Computer Vision: Expert techniques for training deep neural networks using TensorFlow and Keras" by Rajalingappaa Shanmugamani. Publisher: Packt Publishing, First Edition**, 2018.**

Course Name: Speech Recognition (3-0-6- 6)

Course objective:

- Processing the naturally spoken language is one of the complex tasks faced by researchers. In this module, you will learn about Natural Language Processing and how Deep Learning models can be used to build speech recognition applications.

Course Outcome:

CO1: Understanding of speech recognition concepts.

CO2: Familiarity with software tools in speech recognition, such as Kaldi, CMU Sphinx, and TensorFlow.

CO3: Speech signal processing.

CO4: Use of n-grams, hidden Markov models, and recurrent neural networks to recognize speech in local and regional languages.

Topics Covered:

- Overview of Speech Recognition and Basic APIs
- Advanced NLP using Word Embeddings
- Word2Vec, GLOVE
- Sequence Models to Audio Applications
- Recurrent Neural Networks- RNN
- RNN for Sequence Modelling
- Time Series Foercasting with RNN
- Hands –on Practice on Chatbot Architecture, Building a Chatbot with Dialogflow and Building Alexa.

Textbooks and References:

1. "Automatic Speech Recognition: A Deep Learning Approach" by Dong Yu and Li Deng. Publisher: Springer, First Edition, 2016.
2. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin. Publisher: Pearson, Third Edition, 2019.
3. "Deep Learning for Speech Recognition" by Joseph Keshet. Publisher: Springer, First Edition, 2017.
4. "Fundamentals of Speech Recognition" by Lawrence Rabiner and Biing-Hwang Juang. Publisher: Prentice Hall, First Edition, 1993.