M. Tech in Applied Artificial Intelligence

Semester	Course Code	Course Name	Type	L	T	P	Credits
Semester 1 15 credits		Programming for Data Science	DC	3	0	2	4
		Statistics For Machine Learning	DC	3	0	2	4
		Computer Vision	DC	3	0	2	4
		Data Transformation	DC	2	0	2	3
Semester 2 20 credits		Neural Networks	DC	3	0	2	4
		Machine Learning Algorithms And Applications	DC	3	0	2	4
		Elective 1	DE	3	0	2	4
		Elective 2	DE	3	0	2	4
		Mini Project	DC	-	-	-	4
Semester 3 10 credits		Elective 3	DC	3	0	2	4
		Elective 4	DE	3	0	0	3
		Dissertation - Phase I	DC	-	-	-	3
Semester 4 9 credits		Dissertation - Phase II	DC	-	-	-	9
		Personality Development And Communication Skills	Audit	-	-	-	0

Electives	L	T	P	Credits
Internet of Things And Embedded Systems	3	0	2	4
Deep Learning Techniques	3	0	2	4

Natural Language Processing	3	0	2	4
Big Data Analytics	3	0	2	4
Deployment Of ML Models	2	0	2	3
AI in Healthcare	3	0	2	4
Applied Signal Processing	3	0	2	4
AI Workshop	1	0	4	3

SN	**Category of Course**	**Symbol**	**Credit Requirement**			
			M. Tech. in Applied AI (2 Year)			
	Program Core					
1	Departmental core	DC			39	
Program Elective						
2	Departmental Elective	DE			15	
Total requirement : DC+ DE =					**54**	

<table>
<tr><td>Course Code</td><td>-</td><td>Course Title</td><td colspan="4">Programming For Data Science</td></tr>
<tr><td>Category</td><td>-</td><td>Credit Assigned:</td><td colspan="4"><table><tr><td>L</td><td>T</td><td>P</td><td>C</td></tr><tr><td>2</td><td>0</td><td>2</td><td>3</td></tr></table></td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td colspan="4">ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="6">Course Outcomes:
On successful completion of the course, students shall be able to:
1. Understand syntactical and programming concepts.
2. Understand object-oriented concepts.
3. Analyze and apply different methods for error handling.
4. Understand important Python libraries related to data science and how to apply them to given programming tasks.
5. Understand concepts like environments and version control.</td></tr>
<tr><td colspan="6">Course Content:
Module 1 : Introduction to Data Science using Python

What is Data Science, what does a data scientist do? Various examples of Data Science in the industries, How Python is deployed for Data Science applications, Various steps in the Data Science process like data wrangling, data exploration and selecting the model. Introduction to Python programming language, Important Python features, how is Python different from other programming languages, Python installation, Anaconda Python distribution for Windows, Linux and Mac, How to run a sample Python script, Python IDE working mechanism, Running some Python basic commands, Python variables, data types and keywords.

Module 2 : Python basic constructs

Introduction to a basic construct in Python, Understanding indentation like tabs and spaces, Python built-in data types, Basic operators in Python, Loop and control statements like break, if, for, continue, else, range() and more., File Handling (I/O) and Exception Handling, Pandas, Understanding the OOP paradigm like</td></tr>
</table>

encapsulation, inheritance, polymorphism and abstraction ,What are access modifiers, instances, class members, Classes and objects, Function parameter and return type functions, Lambda expressions.

Module 3 : NumPy for Data Transformation

Introduction to mathematical computing in Python, What are arrays and matrices, array indexing, array math, Inspecting a NumPy array, NumPy array manipulation

Module 4 : Scipy for Mathematical Computing

Introduction to SciPy, Functions building on top of NumPy, cluster, linalg, signal, optimize, integrate, subpackages, SciPy with Bayes Theorem.

Module 5 : Data manipulation & Data Visualization

Loading data from various files (.dat, .json, .h5, .txt, .csv, .xlsx etc.), Example applications, Introduction to Matplotlib, Using Matplotlib for plotting graphs and charts like Scatter, Bar, Pie, Line etc., Histogram and more, Matplotlib APIs

Text Books:

1. Wes McKinney: Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, 2017
2. How to think like a computer scientist: Learning with Python by Jeffrey Elkner, Allen B. Downey, and Chris Meyers

Reference Books:

1. "Python Programming: A Complete Guide For Beginners To Master And Become An Expert" by Brian Draper

Course Code	-	Course Title	Statistics For Machine Learning			
Category	-	Credit Assigned:	L	T	P	C
			3	0	0	3

Prerequisite(if Any)	-	Type of Course	ME Applied Artificial Intelligence

Course Outcomes:

On successful completion of the course, students shall be able to:

1. Have an understanding of descriptive and inferential statistics constructs for statistical analysis
2. Gain Knowledge of probability theory and its implementation for data analysis.

Course Content:

Module 1 : Fundamentals of Probability and Statistics

Probability spaces, Conditional probability, Independence, Random Variables, Discrete and Continuous random variables, Expectation Operator, Functions of random variables, Generating random variables, Multivariate Random Variables, Joint distributions of discrete and continuous variables, Functions of several random variables, Joint Moments, Generating multivariate random variables

Module 2 : Random Processes - Convergence, Markov Chains and Applications

Definition, Stationary of random processes, Mean and autocovariance, functions, Independent identically-distributed sequences, Power spectral density, Gaussian process, Poisson process, Random walk, Convergence of Random Processes, Types of convergence, Law of large numbers, Central limit theorem, Monte Carlo simulation, Time-homogeneous discrete-time Markov chains, Recurrence, Periodicity, Convergence, Markov-chain Monte Carlo, Descriptive statistics, Histogram, Sample mean and variance, Order statistics, Sample covariance, Sample covariance matrix

Module 3 : Frequentist Statistics, Regression, Bayesian Statistics and Hypothesis Testing

Independent identically-distributed sampling, Mean square error, Consistency, Confidence intervals, Nonparametric model estimation, Parametric model estimation, Linear Regression models, Least-squares estimation, Overfitting, Global warming. Bayesian parametric models, Conjugate prior, Bayesian estimators, The hypothesis-testing framework, Parametric testing, Nonparametric testing: The permutation test, Multiple testing

Module 4 : Linear Algebra

Vector space, norm, linear mapping, range, null space, matrix multiplication

Module 5 : Optimization Techniques

Normal equation, Steepest Descent, Conjugate gradient, Optimality condition, Methods based on a local quadratic model, Line search methods

Text Books:

1. Probability and Statistics for Data Science, by Carlos Fernandez-Granda
2. Probability for Statistics and Machine Learning: Fundamentals and Advanced Topics, by Anirban Das

Gupta
3. Probability, random variables, and stochastic processes, by Athanasios Papoulis.
4. S. Lang, *Introduction to Linear Algebra*, Springer-Verlag, 2/e, 1997
5. Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong. Mathematics for machine learning.Cambridge University Press, 2020.

Reference Books:

1. Machine learning: a probabilistic perspective by Kevin Murphy
2. Statistical Learning Theory by Vladimir N. Vapnik

Course Code	-	Course Title	Computer Vision			
Category	-	Credit Assigned:	L	T	P	C
			3	0	0	3
Prerequisite(if Any)	-	Type of Course	ME Applied Artificial Intelligence			

Course Outcomes:

On successful completion of the course, students will:

1. know computer vision fundamentals (image formation and image processing).
2. be familiar with different feature extraction techniques and their applications.
3. be conversant with basics of image segmentation and different image segmentation algorithms.
4. be familiar with basic pattern recognition methods.
5. be conversant with basics of multi view imaging and depth estimation.

Course Content:

Module 1

Introduction about computer vision: What is computer vision, advantages and disadvantages of computer vision, general applications of computer vision.

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG.

Module 2

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Module 3

Pattern Analysis: Clustering: K-Means, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Module 4

Computational imaging: Image sensor, noise, HDR, super resolution, blur removal, compressive sensing, Depth estimation and Multi-camera views: projective geometry, binocular stereo, stereo matching, Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Case studies: ADAS, 3D modeling from LiDar point clouds etc.

Text Books:

1 Shapiro and Stockman Computer Vision Illustrated edition Prentice Hall

2. Rafael C. Gonzalez and Richard E. Woods Digital image processing 3rd edition Pearson Education

3. Christopher Bishop Pattern Recognition and Machine learning Illustrated edition Springer

4 Richard Hartley and Andrew Zisserman Multiple View Geometry in Computer Vision 2nd edition Cambridge University Press

Reference Books:

1. Richard Szeliski Computer Vision: Algorithms and Applications Springer

Course Code	-	Course Title	Data Transformation
Category	-	Credit Assigned:	L: 2, T: 0, P: 2, C: 3
Prerequisite(if Any)	-	Type of Course	ME Applied Artificial Intelligence

Course Outcomes:

On successful completion of the course, students shall be able to:

1. You will have an Understanding and knowledge of Database Management System and various characteristics of DBMS
2. Understanding of Relational Models and Structured Query Language
3. Writing sql queries for data transformation

Course Content:

Module 1 : Introduction to Querying Language and RDBMS

Introduction to Structured Query Language, Various types of databases, Distinction between client server and file server databases, Understanding SQL Server Management Studio, SQL Table basics, Data types and functions, Transaction-SQL, Authentication for Windows, Data control language, Identification of the keywords in SQL

Module 2 : Database normalization and entity-relationship model

Entity-Relationship Model, Entity and Entity Set, Attributes and types of Attributes, Relationship Sets, Degree of Relationship, Mapping Cardinalities, One-to-One, One-to-Many, Many-to-one, Many-to- many, Symbols used in E-R Notation, Normalization and functional Dependencies: 1NF, 2NF, 3NF, Boyce Codd NF, 4NF and 5NF

Module 3 : Operators for Querying Databases

Introduction to relational databases, Fundamental concepts of relational rows, tables, and columns, Several operators (such as logical and relational), constraints, domains, indexes, stored procedures, primary, foreign and unique keys, Understanding group functions

Module 4 : Querying Databases using Join, tables, and variables

Advanced concepts of SQL tables, SQL functions, Operators & queries, Table creation, Data retrieval from tables, Combining rows from tables using inner, outer, cross, and self joins, Deploying operators such as intersect, except, union, Temporary table creation, Set operator rules, Table Variables, Understanding SQL functions, Scalar functions, Aggregate functions, Functions that can be used on different datasets, such as numbers, characters, strings, and dates, Inline SQL functions, General functions, Duplicate Functions, Understanding SQL subqueries and their rules, Statements and operators with which subqueries can be used, Using the set clause to modify subqueries, Understanding different types of subqueries, such as where, select, insert, update, delete, etc., Methods to create and view subqueries

Module 5 : Advanced Queries for Large Databases

Learning SQL views, Methods of creating, using, altering, renaming, dropping, and modifying views, Understanding stored procedures and their key benefits, Working with stored procedures, Studying user-defined functions, Error handling, User-defined functions and rank, Types of UDFs such as scalar, Inline table value, Multi-statement table, Stored procedures, Triggers, Records grouping, searching, sorting, modifying data, Clustered indexes creation, Use of indexes to cover queries, Common table expressions, Index guidelines, Python as front end, Large datasets, Querying using No-SQL

Text Books:

1. Fundamentals of Database Systems by R. Elmasri and S. B. Navathe
2. Database Systems Design, Implementation, & Management by Carlos Coronel Steven Morris
3. Database Management Systems by Raghu Ramakrishnan, Johannes Gehrke
4. An Introduction to Database Systems By C. J. Date

Reference Books:

1. "Database Systems : A Practical Approach to Design, Implementation and Management" by CONNOLLY

<table>
<tr><td>Course Code</td><td>-</td><td>Course Title</td><td colspan="4">Neural Networks</td></tr>
<tr><td rowspan="3">Category</td><td rowspan="3">-</td><td rowspan="3">Credit Assigned:</td><td colspan="4"></td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td colspan="4">ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="7">Course Outcomes:

On successful completion of the course, students shall be able to:
1. You will be proficient in Basic concepts of artificial intelligence
2. Have an Understanding of neural networks and their applications
3. Gain Knowledge of deep neural networks and their implementations.</td></tr>
<tr><td colspan="7">Course Content:
Module 1:
Neural network working, Backpropagation and Gradient Descent algorithms. Introduction to deep neural network, Role of vectorization in various operations in deep learning. Comparisons of shallow and deeper networks.

Module 2:
Hyperparameter and its tuning in converging deep networks. Gradient descent optimization algorithms and its importance such as Adam’s algorithm and RMSProp. Introduction and importance of domain knowledge in deep learning.

Module 3:
Convolutional neural networks, its architecture, deep CNN, parameter sharing, and applications.
Recurrent neural networks and its architectural variants such as LSTM, GRU. Architectural aspects and applications. Hybridization of deep models.</td></tr>
</table>

Module 4:
Popular and State-of-the-art Models-, AlexNet, VGG16, Inception, Xception etc., Auto-encoders (AE), Variational AE, Generative Adversarial Networks

Module 5:
Applications of deep learning models to computer vision, natural language processing, and wind estimation. Research direction in deep learning.

Text Books: Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.

Reference Books:

1. Dive into Deep Learning, Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola
2. François Chollet, Deep Learning with Python, Manning Publications, 2017.
3. N. CRISTIANINI, J. S-TAYLOR (2000), An Introduction to Support Vector Machines and Other Kernel- based Learning Methods, Cambridge University Press, 1st Edition.

Course Code	-	Course Title	Machine Learning Algorithms And Applications
Category	-	Credit Assigned:	L: 3, T: 0, P: 0, C: 3
Prerequisite(if Any)	-	Type of Course	ME Applied Artificial Intelligence

Course Outcomes:
On successful completion of the course, students shall be able to:

1. You will be proficient in Supervised and Unsupervised Learning
2. Learn and master Various machine learning algorithms to solve classification, regression and clustering problems.
3. Understand Predictive analytics and modeling

4. Overcome challenges for Model optimization and evaluation metrics

Course Content:

Module 1: Introduction to Machine Learning

Introduction to machine learning, types of learning, Learning Hypothesis, Linear Regression, Inductive classification, applications of Machine Learning ,

Module 2: Hypothesis Evaluation

Training and test splits, Data Pre-processing, cross-validation and parameter tuning, K-fold cross validation, Confusion matrix, Estimating hypothesis accuracy, sample and true error.

Module 3: Decision Trees: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Overfitting, noisy data, and pruning.

Module 4: Support vector machine

Kernel trick, SVM for classification, SVM for Regression

Module 5: Bayesian learning and unsupervised learning

Bayesian Learning: Naive Bayes learning algorithm. Parameter smoothing. Bayes nets and Markov nets for representing dependencies. Hidden Markov Model, and Bayesian networks.

Clustering and unsupervised learning: Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering.

Text Books:

1. Mitchell Tom (1997). Machine Learning, Tata McGraw-Hill
2. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag (2006).

Reference Books:

1. Machine learning: a probabilistic perspective by Kevin Murphy
2. Patterson D.W, Introduction to AI and Expert Systems, Mc GrawHill (1998).
3. Mitchell Tom, Machine Learning. McGraw Hill, 1997.
4. Ethem Alpaydin, Introduction to Machine Learning, PHI

<table>
<tr><td>Course Code</td><td>-</td><td>Course Title</td><td colspan="4">Internet of Things and Embedded Systems</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">-</td><td rowspan="2">Credit Assigned:</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td colspan="4">ME Applied Artificial Intelligence</td></tr>
</table>

Course Outcomes:

On successful completion of the course, students shall be able to:

1. Define and explain various fundamentals of the Internet of Things
2. Learn various fundamentals of embedded C and Micropython programming
3. Examine the evolution of embedded systems, interfacing
4. Learn various wireless and low-energy protocols
5. Create, interface, and develop an application programming frameworrk for cloud connectivity.

Course Content:

Module 1: Getting Started with Fundamentals of Programming using C, Micropython:: Introduction of IoT boards and platforms, Installing IoT integrated development environment. Overview, essentials, and GPIO configurations of IoT platforms. Hands-on IDE, exploring the IoT board GPIOs: Digital Inputs and Outputs, Touch Sensor, Pulse-Width Modulation (PWM), Reading Analog Inputs. Concepts of serial communication, monitoring, plotting, and debugging.

Module 2: Sensor Operation and Interfacing: Interfacing of various sensors like Hall Effect Sensor, Motion Sensor, pressure, temperature, humidity sensor, etc. used in various engineering applications.

Module 3: Interrupts and Timers, Flash Memory, Web Servers: Store Permanent Data (Write and Read), Deep Sleep Mode: Timer, Touch, External Wake Up. Control Outputs: HTML and CSS Basics, Password Protection, Display Sensor Readings, Remote controlling of devices.

Module 4: BLE and Wi-Fi, Cloud-based IoT platform: Bluetooth Low Energy: Introduction, Notify and Scan, Server and Client. Wi-Fi: Access Point, Station modes. Integration of IoT boards with cloud services and their operations. **Module 5: Design and Applications of IoT systems:** Design of various industrial, home, medical, agricultural, smart city, automation, wearable, consumer, and transportation applications of IoT.
Text Books:
Reference Books:

<table>
<tr><td>Course Code</td><td>-</td><td>Course Title</td><td colspan="4">Deep Learning Techniques</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">-</td><td rowspan="2">Credit Assigned:</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td colspan="4">ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="7">Course Outcomes:
On successful completion of the course, students shall be able to:

1. to implement different artificial neural networks for solving different problems with python
2. to employ various convolution neural networks for solving different problems with python
3. to design unsupervised learning algorithms like PCA and autoencoders for solving different problems using python
4. to employ different complex algorithms to handle time series analysis like recurrent neural networks
5. to implement different deep networks using dedicated low cost embedded systems</td></tr>
</table>

Course Content:
Module 1

Different state of the art CNNs, VGG Net, ResNet, Efficient Net. Object detection and tracking, Basic architecture of Mask R CNN, YOLO, YOLO V5, Yolo V7, Deep Sort

Module 2
Synthetic data generation, Variation AE, Adversarial Networks, GAN, Different GANs. GAN vs Variation AE for synthetic data generation.

Module 3

Query, Keys, Value, Attention pooling, Multihead attention, Transformer Architecture, Vision Transformer, Large Scale Pre training with Transformer.

Module 4

Reinforcement Learning, Markov Decision Process, Value Iteration, Q Learning.

Module 5:

Case Studies: DeepFake, etc.

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.

Reference Books:

4. Dive into Deep Learning, Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola
5. François Chollet, Deep Learning with Python, Manning Publications, 2017.
6. N. CRISTIANINI, J. S-TAYLOR (2000), An Introduction to Support Vector Machines and Other Kernel- based Learning Methods, Cambridge University Press, 1st Edition.
7. B. SCHOLKOPF, A. J. SMOLA (2001), Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond, The MIT Press, 2001, 1st Edition.

Course Code	-	Course Title	Personality Development & Communication Skills - I

<table>
<tr><td>Category</td><td>-</td><td>Credit Assigned:</td><td><table><tr><td>L</td><td>T</td><td>P</td><td>C</td></tr><tr><td>1</td><td>0</td><td>2</td><td>2</td></tr></table></td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td>ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="4">Course Content:
Module 1 : Personal Skills
Self-Assessment; Identifying Strength & Limitations, Habits, Will-Power and Drives, Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline, Understanding Perceptions, Attitudes, and Personality Types Mind-Set: Growth and Fixed; Values and Beliefs, Motivation and Achieving Excellence; Self-Actualisation Need, Goal Setting, Life and Career Planning; Constructive Thinking

Module 2: Conflict Resolution Skills
Interpersonal Conflicts, Types Of Conflicts: Becoming A Conflict Resolution Expert, Types Of Stress: Self-Awareness About Stress, Regulating Stress: Making The Best Out Of Stress

Module 3 : Habits Guiding Principles
Habits: Identifying Good And Bad Habits , Habits: Habit Cycle, Breaking Bad Habits, Using The Zeigarnik Effect For Productivity And Personal Growth, Forming Habits Of Success

Module 4 : Professional skills
Organizational skills- teamwork- business and technical correspondence- job oriented skills-professional etiquettes.

Module 5 : Management Skills
Managing Time and Beating Procrastination, Managing People: Leading and Working with Team (Coordination and Cooperation); Developing Accountability, Commitment and Responsibility; Behaving Conscientiously, Managing Stress and Maintaining Positive Outlook, Managing Health, Boosting Memory, Enhancing Study Skills, Managing Money and Love; Balancing Personal and Professional Life</td></tr>
<tr><td colspan="4">Text Books:
1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.</td></tr>
<tr><td colspan="4">Reference Books:</td></tr>
</table>

1. Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

Electives

<table>
<tr><td>Course Code</td><td>-</td><td>Course Title</td><td colspan="4">Natural Language Processing</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">-</td><td rowspan="2">Credit Assigned:</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td colspan="4">ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="7">Course Outcomes:
On successful completion of the course, students shall be able to:
1. Formulate natural language understanding tasks
2. Design and implement basic applications of Natural Language Understanding</td></tr>
<tr><td colspan="7">Course Content:
Module 1 : Natural Language Understanding
Introduction to natural language understanding, Inception, applications, challenges and best practices
Module 2 : Text Mining, Cleaning, and Pre-processing</td></tr>
</table>

Various Tokenizers, Tokenization, Frequency Distribution, Stemming, POS Tagging, Lemmatization, Bigrams, Trigrams & Ngrams, Lemmatization, Entity Recognition

Module 3 : Text classification, sentiment analysis
Overview of Machine Learning, Words, Term Frequency, Countvectorizer, Inverse Document Frequency, Text conversion, Confusion Matrix, Naive Bayes Classifier

Module 4 : Sentence Structure, Sequence Tagging, Sequence Tasks, and Language Modeling

Language Modeling, Sequence Tagging, Sequence Tasks, Predicting Sequence of Tags, Syntax Trees, Context-Free Grammars, Chunking, Automatic Paraphrasing of Texts, Chinking

Module 5 : AI Chatbots and Recommendation Engine
Using the NLP concepts, build a recommendation engine and an AI chatbot assistant using AI

Text Books:

1. Speech and Language Processing, Daniel Jurafsky, James H.Martin,
2. E. BENDER (2013), Linguistic Fundamentals for NLP, Morgan Claypool Publishers..
3. J. ALLEN (1995), Natural Language Understanding, Pearson Education, 1995.
4. Yoav Goldberg Neural Network Methods for Natural Language Processing, Morgan and Claypool (2017)

Reference Books:

1. Introduction to Natural Language Processing, Jacob Eisenstein

Course Code	-	Course Title	Big Data Analytics			
Category	-	Credit Assigned:	L	T	P	C
			2	0	2	3
Prerequisite(if Any)	-	Type of Course	ME Applied Artificial Intelligence			

Course Outcomes:
On successful completion of the course, students shall be able to:
Gain expertise in Big Data Engineering with concepts like big data frameworks, RDDs, and many more.

Course Content:

Module 1 : Working with Big Data Tools and technology

Dimensions of Big Data, Different data types, HDFS, MapReduce Brief and Architecture, Working with Apache Spark

Module 2 : Hadoop Framework

Hadoop Framework (Installation single/multi-node), Data format and movement, Map-Reduce for Hadoop Applications

Module 3 : Introduction to Spark

Introduction to Spark, Spark overcomes the drawbacks of working on MapReduce, Understanding in-memory MapReduce, Interactive operations on MapReduce, Spark stack, fine vs. coarse-grained update, Spark Hadoop YARN, overview of Spark and how it is better than Hadoop, Deploying Spark without Hadoop, Spark history server and Cloudera distribution

Module 4 : Spark Basics and Working with RDDs in Spark

Spark installation guide, Spark configuration, Memory management, Executor memory vs. driver memory, Working with Spark Shell, resilient distributed datasets (RDD), Learning to do functional programming in Spark, architecture of Spark, Spark RDD, Creating RDDs, RDD partitioning, Operations and transformation, Deep dive into Spark RDDs, RDD general operations, Read-only partitioned collection of records, Using the concept of RDD for faster and efficient data processing, RDD action for the collect, count, collects map, save-as-text-files, and pair RDD functions

Module 5 : Advanced Spark and RDD Operations

Aggregating Data with Pair RDDs, Writing and Deploying Spark Applications, Parallel Processing, Spark RDD Persistence, Spark Mllib, Integrating Apache Flume and Apache Kafka, Spark Streaming, Spark SQL and Data Frames

Text Books:

1. Donald Miner and Adam Shook: MapReduce Design Patterns, O'Reilly Media
2. Tom White: Hadoop Definitive Guide, O'Reilly Media
3. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia: Learning Spark: Lightning-Fast Big Data Analysis

Reference Books:

1. Big Data & Hadoop, V.K. Jain, Khanna Publishing House
2. Big Data Black Book, DT Editorial Services, Wiley India

Course Code	-	Course Title	Deployment of ML Models

<table>
<tr><td rowspan="2">Category</td><td rowspan="2">-</td><td rowspan="2">Credit Assigned:</td><td><table><tr><td>L</td><td>T</td><td>P</td><td>C</td></tr><tr><td>2</td><td>0</td><td>2</td><td>3</td></tr></table></td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td>ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="4">Course Outcomes:
On successful completion of the course, students shall be able to:
1. Design ML Systems to solve practical problems.
2. Know how ML system works in production and insights about challenges
3. Identify systems faults and apply strategies to identify root causes in ML systems.
4. Pick up the right framework and compute infrastructure and trade-off space.
5. Troubleshoot training and ensuring the reproducibility of results.</td></tr>
<tr><td colspan="4">Course Content:
Module 1 : Introduction to MLOps
What is MLOps, how and why we use MLOps, MLOps challenges, advantages, applications

Module 2 : MLOps Workflow Management
Introduction to MLOps workflow management, Phases in the analysis life cycle, Evaluation, testing

Module 3 : MLOps Data Lifecycle
MLOps Lifecycle, Components of MLOps life cycle, Challenges, Advantages and best practices

Module 4 : Modeling Pipelines for Scale
Model Resource Management Techniques, High-Performance Modeling, Model Analysis, Interpretability

Module 5 : Deploying Machine Learning Models in Production
Introduction to Machine Learning using Cloud, Deploying Machine Learning Models using Cloud Computing</td></tr>
<tr><td colspan="4">Text Books:
1. “Machine Learning Engineering” by Andriy Burkov, 2020
2. "ML Ops: Operationalizing Data Science" by David Sweenor, Steven Hillion, Dan Rope, Dev Kannabiran, Thomas Hill, Michael O'Connell
3. "Building Machine Learning Powered Applications" by Emmanuel Ameisen</td></tr>
</table>

4. "Building Machine Learning Pipelines" by Hannes Hapke, Catherine Nelson, 2020, O'Reilly

Reference Books:

1. "Introducing MLOps" by Mark Treveil, et al. O'Reilly Media, Inc. 2020
2. "Machine Learning for Data Streams with Practical Examples in MOA", Bifet, Albert and Gavald`a,icard and Holmes, Geoff and Pfahringer, Bernhard, MIT Press, 2018

Course Code	-	Course Title	AI in Healthcare
Category	-	Credit Assigned:	L: 2, T: 0, P: 2, C: 3
Prerequisite(if Any)	-	Type of Course	ME Applied Artificial Intelligence

Course Outcomes:
On successful completion of the course, students shall be able to:

Course Content:

Text Books:

Reference Books:

Course Code	-	Course Title	Applied Signal Processing

<table>
<tr><td>Category</td><td>-</td><td>Credit Assigned:</td><td><table><tr><td>L</td><td>T</td><td>P</td><td>C</td></tr><tr><td>2</td><td>0</td><td>2</td><td>3</td></tr></table></td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td>ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="4">Course Outcomes:
On successful completion of the course, students shall be able to:</td></tr>
<tr><td colspan="4">Course Content:</td></tr>
<tr><td colspan="4">Text Books:</td></tr>
<tr><td colspan="4">Reference Books:</td></tr>
</table>

<table>
<tr><td>Course Code</td><td>-</td><td>Course Title</td><td>AI Workshop</td></tr>
<tr><td>Category</td><td>-</td><td>Credit Assigned:</td><td><table><tr><td>L</td><td>T</td><td>P</td><td>C</td></tr><tr><td>1</td><td>0</td><td>4</td><td>3</td></tr></table></td></tr>
<tr><td>Prerequisite(if Any)</td><td>-</td><td>Type of Course</td><td>ME Applied Artificial Intelligence</td></tr>
<tr><td colspan="4">Course Outcomes:
On successful completion of the course, students shall be able to:</td></tr>
</table>

Course Content:
Text Books:
Reference Books: