AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
(IOIT)
ADDING VALUE TO ENGINEERING
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

ACADEMIC COURSE

STRUCTURE & SYLLABUS

MINOR COURSE

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

B.TECH. 4 YEAR UG COURSE

(Applicable for the batches admitted from 2022-2023)

AISSMS INSTITUTE OF
INFORMATION TECHNOLOGY
Kennedy Road, Near RTO,
Pune- 411-001, Maharashtra State, India
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A. Minor Courses: Artificial Intelligence and Data Science

Sr. No.	Course Code	Course Name	Semester	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADMNR301	Python Programming for Data Science	III	3	--	--	3	--	75*	--	--	--	75
2	ADMNR302	Python Programming for Data Science Laboratory	III	-	--	2	1	---	--	25	--	--	25
3	ADMNR401	Artificial Intelligence	IV	3	--	--	3	--	75*	--	--	--	75
4	ADMNR402	Artificial Intelligence Laboratory	IV	-	--	2	1	---	--	25	--	--	25
5	ADMNR501	Machine Learning	V	3	--	--	3	--	75*	--	--	--	75
6	ADMNR502	Machine Learning Laboratory	V	-	--	2	1	---	--	25	--	--	25
7	ADMNR601	Deep Learning	VI	3	--	--	3	--	75*	--	--	--	75
8	ADMNR602	Deep Learning Laboratory	VI	-	--	2	1	---	--	25	--	--	25
Total				**12**	**--**	**08**	**16**	**---**	**300**	**100**	**--**	**--**	**400**

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Python Programming for Data Science (2022 Course)			
Course Code:	**ADMNR 301**	**Course Title:**	**Python Programming for Data Science**
Contact Hours:	**3 Hrs./week (L)**	**Type of Course:**	**Lecture**
Examination Scheme		**Paper (End Sem)**	**75 Marks**

Pre-requisites: Problem Solving & Programming
Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Semester	External	75

Course Objectives	
1	To explain concepts of Python programming and its diverse applications.
2	To impart hands-on skills through intensive practical exercises, enabling students to solve real-world problems.
3	To introduce popular Python libraries, Numpy and Pandas, and their significance in data handling and analysis.
Course Outcomes : Students will be able to	
301.1	Explain concept of Python programming.
301.2	Implement program using Data Structures.
301.3	Make use of loop structures to implement programs.
301.4	Apply concept of functions to implement programs.

Topics covered:

UNIT-I: PYTHON FOUNDATIONS **(06 Hrs)**

Introduction to Python, Why Python is best for Data Science, Variables and Data Types, Basic Operators and expressions, Indentation, Flow/Decision Control statements: Selection/Conditionals, Branching (if-else), Looping/Iterative statements

Self-Study: https://docs.python.org/3/tutorial/controlflow.html

UNIT-II: DATA STRUCTURES AND STRING MANIPULATION **(06 Hrs)**

String, Data Manipulation with .sort(), .pop(), and len(), Slicing Techniques, Append(), extend(), Strings and their Methods, Built-in functions in String: lower(), upper(), title(), capitalized(), swapcase(), maketrans(), split(), String Comparison: casefold() and lower().

Self-Study: https://www.javatpoint.com/python-strings

UNIT- III: ADVANCED PROGRAMMING CONSTRUCTS **(06 Hrs)**

For and While Loops, Break, Continue, pass, else statements, Advanced Functions and Error Handling, File Handling in Python: reading, Writing, Closing, Regular Expressions.

Self-Study: https://www.geeksforgeeks.org/file-handling-python/

UNIT- IV: FUNCTIONAL PROGRAMMING AND COMPREHENSIONS **(06 Hrs)**

Introduction to Functions and Modules ,Need for functions, Lambda Functions and their Applications, Map, Filter, and Reduce Functions, List Comprehensions, Introduction to Modules and Packages, Types of Arguments: Positional, Default, Keyword, Variable length arguments.

Self-Study: https://realpython.com/python-functional-programming/
https://medium.com/@sylvia.shubhangsingh/list-comprehension-map-filter-and-reduce-functional-programming-making-our-life-easy-6b05b397ad8

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UNIT- V: DATA ANALYSIS WITH NUMPY AND PANDAS **(06 Hrs)**
Introduction to Numpy: Arrays and Matrices, Basic Operations in Numpy, Introduction to Pandas: DataFrames and Series, Data Cleaning and Manipulation in Pandas, Libraries used in Data Analysis, Data Analysis Techniques using Numpy and Pandas. **Self-Study**: https://youtu.be/GPVsHOlRBBI
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):* **1.** **2.**

Text Books:

1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Mastering python for data science, Samir Madhavan

NPTEL: Python for Data Science
https://onlinecourses.nptel.ac.in/noc22_cs32/preview

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Python Programming for Data Science Laboratory (2022 Course)			
Course Code:	**ADMNR302**	**Credit**	**1**
Contact Hours:	**2 Hrs/week (L)**	**Type of Course:**	**Practical**
Examination Scheme		**Term Work:25 Marks**	

Pre-requisites:
Problem Solving & Programming
Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	External	25

Course Objectives	
1	To explain concepts of Python programming and its diverse applications.
2	To impart hands-on skills through intensive practical exercises, enabling students to solve real-world problems.
3	To introduce popular Python libraries, Numpy and Pandas, and their significance in data handling and analysis.
Course Outcomes : Students will be able to	
302.1	Explain concept of Python programming.
302.2	Implement program using Data Structures.
302.3	Make use of loop structures to implement programs.
302.4	Apply concept of functions to implement programs.
302.5	Apply knowledge of data analysis.

Group A (At least Seven)	
1	Installation of Python, Setting Python environment and execute a simple "Hello World!" script.
2	Perform basic arithmetic operations and handle user input.
3	Implement Contact book: Use dictionaries to store and retrieve contact details, allowing users to add, view, and search for contacts.
4	Perform String operations like reversing, counting vowels, word replacement, etc.
5	Design a basic quiz game where users answer questions; use loops and conditionals to manage user experience.
6	Implement Simple log parser: Read a file and extract specific data from it, using string methods and possibly regular expressions.
7	Design Expense tracker: Allow users to input daily expenses, categorize them, and analyze (e.g., highest expense, total spent, etc.) using lambda and filter functions.
8	Design Module explorer: Introduce of different Python modules, import and explore basic functionalities.
Group B(At least Four)	
9	Implement array and matrix operations in Numpy, including creation, manipulation and basic linear algebra.
10	Mini calculator project: Implement basic arithmetic operations through functions and provide a user interface for input and operation selection.
11	Implement Pandas data analysis project: Use a sample dataset, clean, process, and

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	analyze the data, extracting meaningful insights using Pandas functionalities.
12	Implement on Missing Data in Pandas: Use functions for detecting, removing, and replacing null values in Pandas.
13	Implement Pandas data analysis project: Use Slicing, Indexing, Manipulating and Cleaning in Pandas
Group C(Compulsory)	
14	Implement Project for Predicting Weather
15	Implement Project for Predicting price of pre-owned cars
16	Implement Project to Classifying personal income.
17	**Content Beyond the Syllabus:** Computer Science and Engineering-Python Programming Lab: List of Experiments: 1. Arithmetic Operations - https://python-iitk.vlabs.ac.in/exp/arithmetic-operations/ 2. Strings - https://python-iitk.vlabs.ac.in/exp/strings/

Experiments:

Text Books:

1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Mastering python for data science, Samir Madhavan

NPTEL: Python for Data Science
https://onlinecourses.nptel.ac.in/noc22_cs32/preview

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Second Year Artificial Intelligence & Data Science (2022 Course) Artificial Intelligence			
Course Code:	ADMNR401	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE =60*	**Total Marks:**	100

Pre-requisites: Data Structures.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60*

Course Objectives	
1	To understand the concepts of Artificial Intelligence and its applications
2	To learn the concepts of searching for AI problems
3	To understand Adversarial Search & Constraint Satisfaction Problems
4	To learn about Agents and Knowledge Representation
5	To use the concepts of Planning & Acting in the real world
6	To choose the Best Hypothesis from various observations

Course Outcomes : Students will be able to	
402.1	Explain the concepts of Artificial Intelligence and its applications
402.2	Apply various searching algorithms to solve real life problems
402.3	Illustrate Constraint Satisfaction Problems & Adversarial Search
402.4	Represent real world knowledge using first order or propositional logic
402.5	Apply the concepts of Planning & Acting in the real world
402.6	Evaluate the Best Hypothesis from various observations

Topics covered:

UNIT-I: Introduction & Problem-Solving **(06 Hrs)**

Introduction, Foundation, History and Application of AI, Intelligent Agents, Define Problems as a State Space Search, Solving Problems, Problem-Solving Agents, Searching for Solutions, **Strategies:** Greedy Strategy, Divide and Conquer Strategy; **Uninformed Search Strategies:** Breadth-First Search, Depth-First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, **Informed Search Strategies:** Greedy best-first search, A*, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT-II: Adversarial Search & Constraint Satisfaction Problems **(06 Hrs)**

Adversarial Search: Games, Optimal Decisions in Games, Optimal Strategies, Minimax Algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Stochastic Games, Partially Observable Games, **Constraint Satisfaction Problems (CSP):** Constraint Propagation: Inference in CSPs; Backtracking Search for CSPs: Variable and Value Ordering, Intelligent Backtracking; Local Search for CSPs.

UNIT-III: First-Order Logic & Knowledge **(06 Hrs)**

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-

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Order Logic.
UNIT-IV: Knowledge Representation **(06 Hrs)** Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.
UNIT-V: Planning & Acting **(06 Hrs)** Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches, Time, Schedules and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning.
UNIT-VI: Learning from Observations **(06 Hrs)** Information, Inductive Logic Programming.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)

Text Books:

1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Reference Books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Introduction to AI & Expert System: Dan W. Patterson, PHI.
3. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley

EBooks:

https://courses.csail.mit.edu/6.034f/ai3/rest.pdf

MOOC Course:

1. Introduction to Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc22_cs56/preview - Course (nptel.ac.in)

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Second Year Artificial Intelligence and Data Science (2022Course) Artificial Intelligence Laboratory			
Course Code:	ADMNR402	**Credit**	01
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	TW - 25	**Total Marks**	25

Pre-requisites:

- Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Semester Examination	TW	25

Course Objectives	
1	To learn basics of object oriented programming.
2	To know constructor inheritance & overloading.
3	To review different type of file operation.
4	To illustrate exception handling & template.
Course Outcomes: Students will be able to	
402.1	Identify features of object oriented programming.
402.2	Identify constructor inheritance & overloading.
402.3	Categorize type of file operation
402.4	Implement exception handling & template.
Topics covered:	

List of Experiment:

Group A (At least four)	
1	Implementation of Depth First Search for Water Jug problem.
2	Implementation of Breadth First Search for Tic- Tac – Toe problem
3	Solve 9- puzzle problem using Best First Search.
4	Write a program to solve N-Queens problem using Greedy approach.
5	Implementation of Traveling Salesman problem.
6	Min max algorithm in game theory program using python.
7	Implement A star (A*) Algorithm for any game search problem.
8	Implement a solution for a Constraint Satisfaction Problem using Branch and Bound for n-queens problem.
Group B	
7	Implement Alpha-Beta Tree search for any game search problem.
8	Implement Greedy search algorithm for Single-Source Shortest Path Problem
9	Employee Scheduling algorithm using python
10	Implement Greedy search algorithm for Minimum Spanning Tree
11	Implement Greedy search algorithm for Dijkstra's Minimal Spanning Tree Algorithm
Group C(Compulsory)	

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12	Implement interval scheduling algorithm using python or C++
13	Implement decision Tree
14	Airline scheduling algorithm.

Text Books:

1.E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, raw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990

2. Herbert Schildt, "C++-The complete reference"‖, Eighth Edition, McGraw Hill Professional, 2011, ISBN: 978-00-72226805

Reference Books:

1. Data Structures and Algorithm Analysis in C++ Hardcover, by Mark A. Weiss, Jun 2013, Publisher: PHI; 4 editions, ISBN-10: 013284737X ISBN-13: 978-0132847377.
2. Algorithms in C++: Fundamentals, Data Structures, Sorting, Searching, Parts 1-4, 3rd Edition (Paperback), Pearson India, ISBN-10 8131713059, 2009, ISBN-13 9788131713051.

References:

1. https://nptel.ac.in/content/syllabus_pdf/106105166.pdf
https://ece.unm.edu/featured-students/spotlight-images/ece1d-intro-to-io

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Third Year Artificial Intelligence & Data Science (2022 Course) Machine Learning			
Course Code	ADMNR501	**Credit**	03
Contact Hours	03 Hrs/weeks((L)	**Type of Course**	Lecture
Examination Scheme	ISE: 40Marks ESE: 60 Marks	**Total Marks**	100

Pre-requisites:

- Problem Solving and Programming
- Discrete Mathematics & Statistics
- Artificial Intelligence

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In Semester Evaluation	Internal	40#
2.	End Semester Evaluation	External	60*

Course Objectives	
1	To discuss machine learning concepts & types of machine learning
2	To introduce regression & classification.
3	To illustrate on unsupervised learning algorithms.
4	To discuss Artificial Neuron Model
5	To explain Multilayer perceptron (MLP) and back propagation algorithm.
6	To disseminate forms of learning

Course Outcomes : Students will be able to	
501.1	Explain the basic concepts in Machine Learning and to broadly classify various types of machine learning algorithms.
501.2	Analyze Mathematically, compare and design machine learning algorithms for classification and regression.
501.3	Analyze Mathematically, the effect of dimensionality reduction. Evaluate and interpret the results of the algorithms.
501.4	Apply the fundamentals of Artificial Neural Network (ANN) to design and implement ANN algorithms.
501.5	Classify the multilayer perceptron for classification.
501.6	Design and implement neural networks to particular applications.

Topics covered:

UNIT-I: Introduction to Machine Learning **(06 Hrs)**

Introduction to Machine learning, Learning paradigms: Supervised, Unsupervised, Semi-Supervised, Reinforcement Learning, parametric and non-parametric modeling, Bias-Variance, over fitting, under fitting, and Generalize model. Dimensionality reduction. Feature reduction, Decision trees.

UNIT-II: Supervised Learning Techniques **(06 Hrs)**

Regression: Least Squares regression, Types of regression: Linear Regression and nonlinear regression, Nearest Neighbors, Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison Linear Models for Classification: Discriminant Functions. Probabilistic Discriminative Models Multivariate

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Data, Parameter Estimation, Multivariate Classification, Multivariate Regression Kernel Methods: Support Vector machines and Relevance Vector Machines.
UNIT- III: Unsupervised Learning Techniques **(06 Hrs)** Dimensionality Reduction: Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis Clustering: k-Means Clustering, Mixtures of Gaussians.
UNIT- IV: Artificial Neural Networks I **(06 Hrs)** Biological neuron, Artificial neuron model, concept of bias and threshold, types of Activation functions: sigmoid function (Unipolar sigmoid), Hyperbolic tangent (bipolar sigmoid) function, Hard Limiter, Piecewise linear, Linear, McCulloch-Pits Neuron Model, learning paradigms, concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Learning mechanisms: Hebbian, Gradient descent, Competitive, Stochastic, Delta Rule, Perceptron and its limitations.
UNIT- V: Artificial Neural Networks II **(06 Hrs)** Multilayer perceptron (MLP), Feed-forward neural network, Feedback neural network, back propagation algorithm, Application of MLP for classification, Self-Organizing Feature Maps, Learning vector quantization, Radial Basis Function.
UNIT- VI: Attractor Neural Networks **(06 Hrs)** Associative Learning, Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.) **1. II,III.**

Text Books:

1. Christopher Bishop, —Pattern Recognition and Machine Learning‖, Springer, 2007.
2. Laurene Fausett ,‖ Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, Inc, 2008.
3. "Probability and Statistics for Engineering and the Sciences", Jay Devore, Eighth Edition

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, —The Elements of Statistical Learning‖, Springer 2009.
3. Phil Kim, —MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence‖,a Press 2017.
4. EthemAlpaydın —Introduction to Machine Learning‖ Second Edition The MIT Press 2010.
5. SimonHaykin,‖ Neural Networks : A comprehensive foundation, Prentice Hall International Inc. 1999.

EBooks:

1. Machine - Learning - Tom Mitchell
2. Machine Learning (etc.) (z-lib.org)

MOOC Course:

1. Introduction to Machine Learning - Course (nptel.ac.in)

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Third Year Artificial Intelligence & Data Science (2022 Course) Machine Learning Laboratory			
Course Code	ADMNR502	**Credit**	02
Contact Hours	04 Hrs/weeks((L)	**Type of Course**	Practical
Examination Scheme	TW: 25 marks PR: 25 marks	**Total Marks**	50

Pre-requisites:

- Problem Solving and Programming
- Discrete Mathematics & Statistics

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	25
2.	Practical	External	25

Course Objectives	
1	To enable students to gain hands-on experience in designing, training, and Evaluating machine learning using popular libraries.
2	To introduce students to transfer learning and fine-tuning pre-trained models for Specific applications.
3	To teach students how to evaluate the performance of machine learning models.

Course Outcomes : Students will be able to	
502.1	To experiment on fundamental concepts of regression and principles of machine learning and identify key components of machine learning models.
502.2	To analyze and evaluate the performance of machine learning models and interpret the results.
502.3	Develop novel machine learning solutions for complex problems and applications.
502.4	Explore and experiment with emerging trends and advanced machine learning architectures.

Sr. No.	Name of the program Group (A) (Any Seven)
1.	Write a python program to compute • Central Tendency Measures: Mean, Median, Mode • Measure of Dispersion: Variance, Standard Deviation
2.	Study of Python Basic Libraries such as Statistics, Math, Numpy, Sys and Scipy
3.	Study of Python Libraries for ML application such as Pandas,Matplotlib and Seaborn
4.	Implement a linear regression model with a single neuron model
5.	Implementation of Multiple Linear Regression using sklearn (House price prediction/Loan defaulter etc.)
6.	Implementation of Decision tree using sklearn and its parameter tuning
7.	Implementation of K Nearest Neighbor's(KNN) using sklearn
8.	Implementation of K-Means Clustering
Sr.	Group (B) (Any Four)

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No.	
9.	Implement Support Vector machines (SVM) classifier for classification of data into two classes. Students can use datasets such as flower classification etc.
10.	Implement simple logic network using Multilayer perceptron (MP) neuron model
11.	Implement the finite words classification system using Back-propagation algorithm
12.	Implement Self-Organizing Feature Maps (SOFM) for character recognition.
13.	Implement and test Radial Basis Function (RBF) network
Sr. No.	**Group (C) Mini Project (Any One)**
14.	Predicting House Prices: **Project Statement:** Build a regression model to predict house prices based on features such as square footage, number of bedrooms, neighborhood, etc. **Dataset:** You can use the "House Prices: Advanced Regression Techniques" dataset from Kaggle.
15.	Classification of Iris Flowers: **Project Statement:** Create a classification model to classify iris flowers into different species (setosa, versicolor, virginica) based on features like sepal length, sepal width, petal length, and petal width. **Dataset:** The Iris dataset is a classic dataset and can be easily accessed from libraries like Scikit-Learn.
16.	Sentiment Analysis for Movie Reviews: **Project Statement:** Develop a sentiment analysis model that determines whether movie reviews are positive or negative based on the text of the reviews. **Dataset:** You can use the IMDb movie reviews dataset available on Kaggle.
17.	Automation of price prediction using machine learning in a large furniture company.

Text Books:

1. Christopher Bishop, —Pattern Recognition and Machine Learning‖, Springer, 2007.
2. Laurene Fausett ,‖ Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, Inc, 2008.
3. "Probability and Statistics for Engineering and the Sciences", Jay Devore, Eighth Edition

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, —The Elements of Statistical Learning‖, Springer 2009.
3. Phil Kim, —MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence‖,a Press 2017.
4. EthemAlpaydın —Introduction to Machine Learning‖ Second Edition The MIT Press 2010.
5. SimonHaykin,‖ Neural Networks : A comprehensive foundation, Prentice Hall International Inc. 1999.

EBooks:

1. Machine - Learning - Tom Mitchell
2. Machine Learning (etc.) (z-lib.org)

MOOC Course:

1. Introduction to Machine Learning - Course (nptel.ac.in)

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Third Year Artificial Intelligence & Data Science (2022 Course) Deep Learning			
Course Code	ADMNR601	Credit	03
Contact Hours	03 Hrs/weeks((L)	Type of Course	Lecture
Examination Scheme	ISE:40Marks ESE: 60 Marks	Total Marks	100

Pre-requisites:

- Exploratory Data Analysis
- Machine Learning

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In Semester Evaluation	Internal	40
2.	End Semester Evaluation	External	60 *

Course Objectives	
1	To introduce the concept of deep learning.
2	To describe the significance of convolutional neural networks.
3	To explore the purpose and functionality of recurrent neural network.
4	To describe the different types of auto encoders.
5	To explain the fundamental concepts of deep generative models.
6	To explain the fundamental concepts of reinforcement learning, including Markov Decision Processes (MDPs), rewards, policies, and value functions.

Course Outcomes : Students will be able to	
601.1	Summarize the concept of deep learning and its importance in the field of artificial intelligence.
601.2	Explain the purpose and functionality of convolutional layers, pooling layers, and activation functions in CNNs.
601.3	Apply different types of RNN architectures and their suitability for specific tasks.
601.4	Analyze the different types of auto encoders.
601.5	Implement generative models using programming languages and frameworks.
601.6	Describe deep reinforcement learning concept and algorithms.

Topics covered:

UNIT-I: INTRODUCTION TO DEEP LEARNING **(06 Hrs)**

Overview and Performance of Machine Learning Algorithm, Need of Deep Learning, Introduction to Deep Learning, Relation between Artificial intelligence, Machine Learning, and Deep Learning, Building Blocks of Deep Networks, Understanding How Deep Learning Works in Three Figures, Deep Learning Models, Application of Deep Learning.

Self-Study: Deep Mind, Alpha Go, Boston Dynamics, Amazon go store

UNIT-II: CONVOLUTIONAL NEURAL NETWORK **(06 Hrs)**

Kernels and Filters, Convolution, Properties of CNN, CNN Architecture Overview, Components of CNN Architectures: Convolutional Layer, Pooling Layer, Fully Connected (FC) Layer, Loss Layer, Training a Convolutional Network, CNN in TensorFlow, Popular CNN Architectures: LeNet, ResNet, AlexNet, Applications.

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Self-Study: VGG
UNIT- III: RECURRENT NEURAL NETWORK **(06 Hrs)** Introduction to RNN, Schematic Representation of an RNN, Varieties of Recursive Neural Networks, Training RNN with Back Propagation Through Time (BPPT), Elman Neural Networks, Practical example of RNN: Pattern Detection, Long Short-Term Memory (LSTM), Traditional LSTM, Modes of LSTM, Properties of LSTM Networks, LSTM Network Architecture, Training LSTM, Time-Series Forecasting with the LSTM model. **Self-Study:** Multi-Digit Number Recognition, Google, bing, DuckDuckGo
UNIT- IV: AUTOENCODERS **(06 Hrs)** Introduction to Autoencoders, Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Predictive Sparse Decomposition, Applications of Autoencoders, Fast Learning Algorithms. **Self-Study:** Autoencoder in Pytorch with MNIST, Anomaly detection in ECG with LSTM Autoencoders
UNIT- V: DEEP GENERATIVE MODELS **(06 Hrs)** Introduction to Deep Generative Model, Boltzmann Machine, Deep Belief Networks, Deep Boltzmann Machines, Generative Adversarial Network (GAN), Discriminator Network, Generator Network, Types of GAN, Applications of GAN networks. **Self-Study:** GAN for detection of real or fake images, chatGPT
UNIT- VI: DEEP REINFORCEMENT LEARNING (6 HRS) Introduction of Deep Reinforcement Learning, Markov Decision Process, Basic Framework of Reinforcement Learning, Challenges of Reinforcement Learning, Dynamic Programming Algorithms for Reinforcement Learning, Simple Reinforcement Learning for Tic-Tac-Toe, Limitations of Deep Learning. **Self-Study:** Self driving cars, Deep learning for chatbots
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.) **Not Required**

Text Books:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville
2. Deep Learning A Practitioner's Approach, Josh Patterson and Adam Gibson, O'Reilly
3. Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma with contributions by Nicholas Locascio, O'Reilly

Reference Books:

1. Deep Learning with Applications Using Python, Navin Kumar Manaswi Bangalore, Karnataka, India, ISBN-13 (pbk): 978-1-4842-3515-7
2. Introduction to Deep Learning Using R A Step-by-Step Guide to Learning and Implementing Deep Learning Models Using R, Taweh Beysolow II San Francisco, California, USA ISBN-13 (pbk): 978-1-4842-2733-6
3. Applied Deep Learning: A Case-Based Approach to Understanding Deep Neural Networks, Umberto Michelucci toelt.ai, Dubendorf, Switzerland, ISBN-13 (pbk): 978-1-4842-3789-2
4. Introduction to Deep Learning, Mrs. Mayura V. Shelke, Dr. S. Padmaja, Dr. Rakesh Bapu Dhumale, Dr. S.H. Abbas, India, ISBN:978-93-5515-954-0
5. Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, The MIT Press Cambridge, Massachusetts London, England

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Third Year Artificial Intelligence & Data Science (2022 Course) Deep Learning Laboratory			
Course Code	ADMNR602	**Credit**	02
Contact Hours	4 Hrs/weeks((P)	**Type of Course**	Practical
Examination Scheme	TW: 25 PR:50	**Total Marks**	75

Pre-requisites:

- Exploratory Data Analysis
- Machine Learning

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To enable students to gain hands-on experience in designing, training, and evaluating deep learning models using popular frameworks.
2	To introduce students to transfer learning and fine-tuning pre-trained models for specific applications.
3	To understand practical approach fundamentals of MLOps.
4	To learn various feature selection impacts on MLOps strategy with ML pipeline.

Course Outcomes: Students will be able to	
602.1	Recall the fundamental concepts and principles of deep learning and identify key components of deep learning models.
602.2	Analyze and evaluate the performance of deep learning models and interpret the results.
602.3	Develop novel deep learning solutions for complex problems and applications.
602.4	Demonstrate MLOps techniques for model training to preparing for Production.
602.5	esign ML pipeline strategies to handle feature selection.

Topics covered:
(Deep Learning)Group A
1. Develop a program to build and train a feed forward neural network from scratch using a deep learning framework like Tensor Flow, keras etc.
2. Multiclass classification using Deep Neural Networks: Example: Use the OCR letter recognition dataset
3. Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset
4. Develop a program to recognize digits using CNN.
5. Build a CNN model to classify images from popular datasets like MNIST,

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CIFAR-10, or Image Net.
Group B (Any 3)
6. Create an RNN-based sentiment analysis system to classify text reviews (such as movie reviews or product reviews) into positive, negative, or neutral sentiments. Use datasets containing labeled text data for training and testing the model's accuracy in sentiment classification
7. Utilize pretrained deep learning models like VGG, ResNet, or Inception to perform transfer learning on a new dataset. Fine-tune the model and evaluate its performance.
8. Develop a program to forecast future values in time series data, such as weather patterns, using RNN models like LSTM or GRU.
9. Implement Auto-encoders for any of the task including: a) Data Compression b) Image de-noising c) Dimensionality reduction
10. Implement a basic GAN to generate synthetic images, starting with a simple dataset like random noise.
11. Implement Q-learning algorithm for a simple game or environment.
Group C (Any one)
12. **Mini Project:** Use an RNN to generate new text based on a training corpus.
13. **Mini Project:** Implement CNN object detection on any data. Discuss numerous performance evaluation metrics for evaluating the object detecting algorithms' performance, Take outputs as a comparative result of algorithm.
14. **Mini Project:** Stock Price Prediction using RNN/LSTM.

Text Books:

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2. Deep Learning A Practitioner's Approach, Josh Patterson and Adam Gibson, O'Reilly
3. Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma with contributions by Nicholas Locascio, O'Reilly
4. Noah Gift , "Practical MLOps: A Guide to Building Real-World Machine Learning Systems", O'Reilly, First Edition, September 2021.
5. Mark Treveil, Nicolas Omont, "Introducing MLOps: How to Scale Machine Learning in the Enterprise", O'Reilly Media, First Edition, January 5, 2021
6. Emmanuel Raj, "Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale", Packt Publishing Limited, 1st edition, 19 April 2021

Reference Books:

1. Deep Learning with Applications Using Python, Navin Kumar Manaswi Bangalore, Karnataka, India, ISBN-13 (pbk): 978-1-4842-3515-7
2. Introduction to Deep Learning Using R A Step-by-Step Guide to Learning and Implementing Deep Learning Models Using R, Taweh Beysolow II San Francisco, California, USA ISBN-13 (pbk): 978-1-4842-2733-6
3. Applied Deep Learning:A Case-Based Approach to Understanding Deep Neural Networks, Umberto Michelucci toelt.ai, Dübendorf, Switzerland, ISBN-13 (pbk): 978-1-4842-3789-2
4. Hannes Hapke and Catherine Nelson, "Building Machine Learning Pipelines: Automating Model Life Cycles with TensorFlow", O'Reilly, First Edition, 19 July 2020.
5. Chris Fregly, Antje Barth, "Data Science on AWS: Implementing End-to-End Continuous Machine Learning Pipelines", O'Reilly, First Edition, 9 May 2021.
6. Sridhar Alla, Suman Kalyan Adari, "Beginning MLOps with MLFlow: Deploy Models in AWS SageMaker, Google Cloud, and Microsoft Azure", Apress publication, 1st edition, 8 December 2020

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Web Resources

Blogs and Websites:

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

Online Courses and Tutorials:

1. Coursera: "Machine Learning Engineering for Production (MLOps)" by deeplearning.ai. This course provides a comprehensive introduction to MLOps, covering topics like data and model versioning, deployment, monitoring, and more.
2. Udacity: "Machine Learning Deployment" by Google Cloud. This course focuses on deploying and scaling machine learning models using Google Cloud technologies and covers MLOps principles

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