VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY HYDERABAD

B.TECH. MINOR IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

COURSE STRUCTURE AND SYLLABUS

(Applicable for the batch admitted in the academic year 2021-2022)

V SEMESTER (III YEAR I SEMESTER) **A19**

Course Code	Title of the Course	L	T	P/D	Contact Hours/ Week	Credits
A19MC1AI01	Foundations of Artificial Intelligence	3	0	0	3	3
A19MC2AI01	Artificial Intelligence Laboratory	0	0	3	3	1.5
Total		**3**	**0**	**3**	**6**	**4.5**

VI SEMESTER (III YEAR II SEMESTER) **A19**

Course Code	Title of the Course	L	T	P/D	Contact Hours/ Week	Credits
A19MC1AI02	Artificial Intelligence Applications	3	1	0	4	4
Total		**3**	**1**	**0**	**4**	**4**

VII SEMESTER (IV YEAR I SEMESTER) **A19**

Course Code	Title of the Course	L	T	P/D	Contact Hours/ Week	Credits
A19ME1AI01	Principles of Machine Learning	3	0	0	3	3
A19ME1AI02	Fundamentals of Deep Learning					
A19ME2AI01	Principles of Machine Learning Laboratory	0	0	3	3	1.5
A19ME2AI02	Fundamentals of Deep Learning Laboratory					
Total		**3**	**0**	**3**	**6**	**4.5**

VIII SEMESTER (IV YEAR II SEMESTER) **A19**

Course Code	Title of the Course	L	T	P/D	Contact Hours/ Week	Credits
A19ME1AI03	Robotics Process Automation	3	0	0	3	3
A19ME1AI04	Natural Language Processing					
A19ME1AI05	Game Theory					
A19ME1AI06	Computer Vision & Robotics					
A19ME1AI07	Speech & Video Processing					
A19ME1AI08	Soft Computing					
A19MP1AI01	Mini-Project	0	0	4	4	2
Total		**3**	**0**	**4**	**7**	**5**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. Minor (AIML) V Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(A19MC1AI01) FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

COURSE OBJECTIVES:

- To review important concepts required for Artificial Intelligence
- To introduce the concept of learning patterns from data and develop a strong model using machine learning algorithms
- To explain theoretical foundation for understanding state of the art Machine Learning algorithms like classifications, regressions
- To understand unsupervised learning technique using partitioning and hierarchical clustering methods

COURSE OUTCOMES: After completion of course, the student should be able to
CO-1: Represent knowledge and facts for solving the real-world problems
CO-2: Build, and Evaluate the model using different Machine Learning techniques
CO-3: Design and implement machine learning solutions to classification, regression
CO-4: Design and implement various unsupervised learning methods to real-world applications

UNIT – I:
Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming.

UNIT – II:
Preparing a Model: Machine learning activities, basic types of data in machine learning, exploring structure of data: Exploring and Plotting numerical data, categorical data and relationship between variables, data quality and remediation, data pre-processing: Dimensionality reduction and feature subset selection

UNIT – III:
Modelling: Selecting a model: Predictive and Descriptive models, Training a model (for supervised learning): Holdout method, K-fold cross-validation method.
Model representation and interpretability: Underfitting, Overfitting, Bias – Variance trade-off.
Evaluation: Evaluating performance of a model: Supervised learning – classification, regression, Unsupervised learning – clustering, Improving performance of a model

UNIT – IV:
Classification: Introduction, example of supervised learning, classification model, classification learning steps, classification algorithms: K-Nearest Neighbour (k-NN), Decision tree.

UNIT – V:
Linear Regression: Model representation for single variable, single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.

Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.

UNIT – VI:

Clustering: clustering as a machine learning task, different types of clustering techniques, partitioning methods, k-medoids, hierarchical clustering. Use-cases centered around classification and clustering.

TEXT BOOKS:

1. Artificial Intelligence, Cengage Learning, Saroj Kaushik, 1st Edition, 2011
2. Python Machine Learning by Example, Yuxi (Hayden) Liu, Packet Publishing Limited, 2017
3. Machine Learning, Saikar Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson India

REFERENCES:

1. Practical Workbook Artificial Intelligence and Soft Computing for Beginners, Anindita Das Bhattacharjee, Shroff, X team Publisher
2. Machine Learning, Tom Mitchell, McGraw-Hill, 2017
3. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2011
4. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. Friedman, 2nd Edition, 2011

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	0	**3**	**1.5**

(A19MC2AI01) ARTIFICIAL INTELLIGENCE LABORATORY

COURSE OBJECTIVES:

- To review important concepts required for Artificial Intelligence
- To introduce the concept of learning patterns from data and develop a strong model using machine learning algorithms
- To explain theoretical foundation for understanding state of the art Machine Learning algorithms like classifications, regressions
- To understand unsupervised learning technique using partitioning and hierarchical clustering methods

COURSE OUTCOMES: After completion of course, the student should be able to
CO-1: Represent knowledge and facts for solving the real-world problems
CO-2: Build, and evaluate the model using different machine learning techniques
CO-3: Design and implement machine learning solutions to classification, regression
CO-4: Design and implement various unsupervised learning methods to real-world applications

LIST OF EXPERIMENTS:

WEEK 1 & 2: Basic programs in Python to get familiarize various programming structures
WEEK 3: Implementation of logical rules in Python
WEEK 4, 5, 6 & 7: Using any data apply the concept of:
a. Liner regression
b. Gradient decent
c. Logistic regression
WEEK 8: Perform and plot overfitting in a data set
WEEK 9 &10: Implementation of KNN classification algorithm
WEEK 11 &12: Implementation of k-means clustering algorithm
WEEK 13: Explore statistical methods for machine learning

TEXT BOOKS:

1. Artificial Intelligence, Cengage Learning, Saroj Kaushik, 1st Edition, 2011
2. Python Machine Learning by Example, Yuxi (Hayden) Liu, Packet Publishing Limited, 2017
3. Machine Learning, Saikar Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson India

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1. Practical Workbook Artificial Intelligence and Soft Computing for beginners, Anindita Das Bhattacharjee, Shroff, X team Publisher
2. Machine Learning, Tom Mitchell, McGraw-Hill, 2017
3. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2011
4. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. Friedman, 2nd Edition, 2011

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B.Tech. Minor (AIML) VI Semester	**L**	**T/P/D**	**C**
	3	**1**	**4**

(A19MC1AI02) ARTIFICIAL INTELLIGENCE APPLICATIONS

COURSE OBJECTIVES:

- To give deep knowledge of AI
- To know how AI can be applied in various fields to make the life easy
- To introduce recent topics in AIML
- To gain and knowledge about robotic process automation, and AI optimized hardware

COURSE OUTCOMES: After completion of course, the student should be able to

CO-1: Correlate the AI and solutions to modern problem
CO-2: Decide when to use which type of AI technique
CO-3: Understand and analyze real world problems using AI techniques
CO-4: Develop solutions using Artificial Intelligence and block chain technologies

UNIT – I:

Linguistic aspects of natural language processing, A.I. And Quantum Computing, Applications of Artificial Intelligence (AI) in business.

UNIT – II:

Emotion Recognition using human face and body language, AI based system to predict the diseases early,

UNIT – III:

Smart Investment analysis, AI in Sales and Customer Support.

UNIT – IV:

Robotic Processes Automation for supply chain management.

UNIT – V:

AI-Optimized Hardware, Digital Twin i.e. AI Modelling, Information Technology & Security using AI.

UNIT – VI:

Recent Topics in AI/ML: AI/ML in Smart solutions, AI/ML in Social Problems handling, Block chain and AI.

TEXT BOOKS:

1. Sameer Dhanrajani, AI and Analytics, Accelerating Business Decisions, John Wiley & Sons
2. Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, Bernard Marr, Matt Ward, Wiley

REFERENCES:

1. Life 3.0: Being Human in the Age of Artificial Intelligence, Max Tegmark, 2018
2. Homo Deus: A Brief History of Tomorrow, Yuval Noah Harari, 2017

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	3	**0**	**3**

(A19ME1AI01) PRINCIPLES OF MACHINE LEARNING

COURSE PRE-REQUISITES: Data Structures, Knowledge on Statistical Methods

COURSE OBJECTIVES:
- To discuss fundamental concepts of machine learning techniques
- To discuss machine learning techniques such as decision tree learning, Bayesian learning
- To understand computational learning theory
- To study the pattern comparison techniques

COURSE OUTCOMES: After completion of course, the student should be able to
CO-1: Understand the concepts of computational intelligence like machine learning
CO-2: Apply machine learning techniques to address the real time problems in different areas
CO-3: Understand the Neural Networks and its usage in machine learning application
CO-4: Analyze and build the models using decision tree and Bayesian learning techniques

UNIT – I:
Introduction: Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning, Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias. Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

UNIT – II:
Artificial Neural Networks-1: Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm. Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks. Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms

UNIT – III:
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length

principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.

UNIT – IV:

Computational Learning Theory: Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning. Instance-Based Learning- Introduction, k-nearest neighbor algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

UNIT – V:

Genetic Algorithms: Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms. Learning Sets of Rules – Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution. Reinforcement Learning – Introduction, the learning task, Q–learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

UNIT – VI:

Analytical Learning-1: Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.

Analytical Learning-2: Using prior knowledge to alter the search objective, using prior knowledge to augment search operators. Combining Inductive and Analytical Learning – Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

TEXT BOOK:

1. Machine Learning, Tom M. Mitchell, McGraw-Hill

REFERENCE:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis

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(A19ME1AI02) FUNDAMENTALS OF DEEP LEARNING

COURSE OBJECTIVES:

- To understand complexity of Deep Learning algorithms and their limitations
- To be capable of performing experiments in Deep Learning using real-world data
- To discuss convolution neural network and computer vision concepts
- To learn fundamental concepts of Deep Learning techniques

COURSE OUTCOMES: After completion of course, the student should be able to

CO-1: Implement deep learning algorithms, understand neural networks and traverse the layers of data

CO-2: Learn concepts such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces

CO-3: Understand applications of Deep Learning to Computer Vision

CO-4: Understand and analyze applications of Deep Learning to NLP

UNIT – I:

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout

UNIT – II:

Convolutional Neural Networks: Architectures, convolution/pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures.

UNIT – III:

Deep Unsupervised Learning: Auto encoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models, Dynamic Memory Models

UNIT – IV:

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention Models for computer vision tasks.

UNIT – V:

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity

UNIT – VI:

Analogy Reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs

TEXT BOOKS:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press
2. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, and J. Friedman, Springer
3. Probabilistic Graphical Models, Koller and N. Friedman, MIT Press

REFERENCES:

1. Pattern Recognition and Machine Learning, Bishop C. M., Springer, 2006
2. Artificial Neural Networks, Yegnanarayana B., PHI Learning Pvt. Ltd., 2009
3. Matrix Computations, Golub G. H., and Van Loan C. F., JHU Press, 2013
4. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004

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	0	**3**	**1.5**

(A19ME2AI01) PRINCIPLES OF MACHINE LEARNING LABORATORY

COURSE OBJECTIVES:

- To get an overview of the various machine learning techniques
- To demonstrate machine learning techniques using python
- To understand how to build the model using machine learning techniques
- To discuss genetic and backpropagation techniques

COURSE OUTCOMES: After completion of course, the student should be able to

CO-1: Understand complexity of Machine Learning algorithms and their limitations

CO-2: Understand modern notions in data analysis-oriented computing

CO-3: Confidently apply common Machine Learning algorithms in practice and implementing their own

CO-4: Perform experiments in Machine Learning using real-world data

LIST OF EXPERIMENTS:

1. The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)
2. Extract the data from database using python.
3. Implement k-nearest neighbors classification using python
4. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k- means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

5. The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.
   medium skiing design single twenties no -> highRisk
   high golf trading married forties yes -> lowRisk
   low speedway transport married thirties yes -> medRisk
   medium football banking single thirties yes -> lowRisk
   high flying media married fifties yes -> highRisk
   low football security single twenties no -> medRisk

medium golf media single thirties yes -> medRisk
medium golf transport married forties yes -> lowRisk
high skiing banking single thirties yes -> highRisk
low golf unemployed married forties yes -> highRisk

Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of `golf' and the conditional probability of `single' given `medRisk' in the dataset?

6. Implement linear regression using python.
7. Implement Naïve Bayes theorem to classify the English text
8. Implement an algorithm to demonstrate the significance of genetic algorithm
9. Implement the finite words classification system using Back-propagation algorithm

TEXT BOOK:

1. Machine Learning, Tom M. Mitchell, McGraw-Hill

REFERENCE:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis

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	0	**3**	**1.5**

(A19ME2AI02) FUNDAMENTALS OF DEEP LEARNING LABORATORY

COURSE OBJECTIVES:

- To build the foundation of Deep Learning
- To understand how to build the Neural Network
- To develop successful machine learning concepts
- To discuss fundamentals concepts of deep learning techniques in the area of Natural language Processing
- To build the natural language processing applications using deep learning concepts

COURSE OUTCOMES: After completion of course, the student should be able to

CO-1: Learn the Fundamental Principles of Deep Learning

CO-2: Identify the Deep Learning Algorithms for various types of learning tasks in various domains

CO-3: Implement Deep Learning Algorithms and solve real-world problems

CO-4: Apply Deep Learning methods to Natural language processing applications

LIST OF EXPERIMENTS:

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Applying the Convolution Neural Network on computer vision problems
4. Image classification on MNIST dataset (CNN model with Fully connected layer)
5. Applying the Deep Learning Models in the field of Natural Language Processing
6. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes
7. Applying the Autoencoder algorithms for encoding the real-world data
8. Applying Generative Adversial Networks for image generation and unsupervised tasks

TEXT BOOKS:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press
2. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, and J. Friedman, Springer
3. Probabilistic Graphical Models, Koller and N. Friedman, MIT Press

REFERENCES:

1. Pattern Recognition and Machine Learning, Bishop C. M., Springer, 2006
2. Artificial Neural Networks, Yegnanarayana B., PHI Learning Pvt. Ltd., 2009
3. Matrix Computations, Golub G. H., and Van Loan C. F., JHU Press, 2013
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004

EXTENSIVE READING:

- http://www.deeplearning.net

- https://www.deeplearningbook.org/
- https://developers.google.com/machine-learning/crash-course/ml-intro
- www.cs.toronto.edu/~fritz/absps/imagenet.pdf
- http://neuralnetworksanddeeplearning.com

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B.Tech. Minor (AIML) VIII Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(A19ME1AI04) NATURAL LANGUAGE PROCESSING

COURSE OBJECTIVES:

- To explain text normalization techniques and n-gram language model
- To discuss part of speech methods and naïve bayes classification techniques
- To understand word sense disambiguation techniques and process of building question answering system
- To introduce the concepts of chatbots, dialogue systems, speech recognition systems and text to speech recognition methods

COURSE OUTCOMES: After completion of course, the student should be able to

CO-1: Apply normalization techniques on a document and evaluate a language model

CO-2: Implement parts of speech tagging and classification techniques on the words

CO-3: Establish relationships among words of a sentence using word net and also build the question answering system

CO-4: Analyze chatbots, dialogue systems, and automatic speech recognition systems

UNIT – I:

Introduction, Regular Expressions, Text Normalization, Edit Distance: Words, Corpora, Text Normalization, Word Normalization, Lemmatization and Stemming, Sentence Segmentation, The Minimum Edit Distance Algorithm.

UNIT – II:

N-gram Language Models: N-Grams, Evaluating Language Model, Sampling sentences from a language model,

Sequence Labeling for Parts of Speech and Named Entities: Part-of-Speech Tagging, Named Entities and Named Entity Tagging

UNIT – III:

Naive Bayes and Sentiment Classification: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Optimizing for Sentiment Analysis, Naive Bayes as a Language Model, Evaluation: Precision, Recall, F-measure, Test sets and Cross-validation

UNIT – IV:

Word Senses and WordNet: Word Senses, Relations Between Senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation, WSD Algorithm: Contextual Embeddings

UNIT – V:

Question Answering: Information Retrieval, IR-based Factoid Question Answering, IR-based QA: Datasets, Entity Linking, Knowledge-based Question Answering, Using Language Models to do QA, Classic QA Models

UNIT – VI:

Chatbots & Dialogue Systems: Properties of Human Conversation, Chatbots, GUS: Simple Frame-based Dialogue Systems, The Dialogue-State Architecture, Evaluating Dialogue Systems, Dialogue System Design,

Automatic Speech Recognition and Text-to-Speech: The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture

TEXT BOOKS:

1. Speech and Language Processing, Dan Jurafsky and James H. Martin, 3rd Edition, Pearson
2. Natural Language Processing with Python, Analyzing Text with the Natural Language Toolkit, Steven Bird, Ewan Klein, and Edward Loper

REFERENCES:

1. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana
2. Foundations of Statistical Natural Language Processing, Christopher Manning and Hinrich Schütze
3. Natural Language Processing in Action- Understanding, Analysing, and Generating Text with Python–Hobson Lane, Cole Howard, Hannes Max Hapke
4. The Handbook of Computational Linguistics and Natural Language Processing, 1st Edition