Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Proposed scheme for Minor in Artificail Intelligence and Machine Learning
(Academic Year 2022-2023)

Sr.	Course Code	Course	Teaching Scheme (hrs.)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th / Cb	O	P	O & P	Total SEA (B)		
Sem V																
1	DJ19MN6C1	Artificial Intelligence	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
Sem VI																
2	DJ19MN6C2	Machine Learning	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
3	DJ19MN6L1	Machine Learning Lab	--	2	--	1	--	25	25	--	--	--	25	25	25	**1**
Sem VII																
4	DJ19MN6C3	Deep Learning	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
5	DJ19MN6L2	Deep Learning Lab	--	2	--	1	--	25	25	--	--	--	25	25	25	**1**
Sem VIII																
6	DJ19MN6C4	Natural Language Processing	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
		Total	**16**	**4**	**0**	**18**	**100**	**50**	**150**	**300**	**0**	**0**	**50**	**350**	**450**	**18**

Program: Third Year B.Tech. (Minor Program in AIML)	**Semester: V**
Course: Artificial Intelligence	**Course Code: DJ19MN6C1**

Teaching Scheme (Hours / week)				**Evaluation Scheme**						
				Semester End Examination Marks (A)			**Continuous Assessment Marks (B)**			**Total marks (A+ B)**
Lectures	**Practical**	**Tutorial**	**Total Credits**	**Theory**			**Term Test 1**	**Term Test 2**	**Avg.**	
				75			**25**	**25**	**25**	**100**
				Laboratory Examination			**Term work**			
4	**-**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**	**Total Term work**	**--**
				-	--	--	-	-	-	

Pre-requisite: Knowledge of

1. Knowledge of any programming language
2. Data Structures

Course Objectives: The objective of this course is

1. To create thorough understanding of AI basics and real-time applications in its sub-domains.
2. To explore AI techniques like informed, uninformed, and adversarial searching to solve real-life problems in a state space tree representation.
3. Familiarize learner to the advance topics of AI such as planning, handling uncertainty.

Course Outcomes: On completion of the course, learner will be able to:

1. Understand the basics of artificial intelligence
2. Solve the problem using appropriate AI techniques.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction** Definition, Foundations of Artificial Intelligence, The State of the Art applications, Future of AI. **Intelligent Agents:** The Concept of Rationality, Agents and Environments (PEAS representation for an Agent), Types of environments, Structure of Intelligent agents, Types of Agents	**06**
2	**Problem solving**	**14**

	Solving Problems by Searching Methods: Types: Uninformed, Informed - Heuristics based. **Uninformed Search**: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. **Informed Search**: Heuristic functions, Best First Search, A* algorithm **Local Search Algorithms and Optimization Problems** - Hill Climbing, Simulated Annealing Searching with Partial Observations **Constraint Satisfaction Problems**: Crypto Arithmetic, Map Coloring, N-Queens, Backtracking Search **Adversarial Search**: Game Playing, Min-Max Search, Alpha Beta Pruning	
3	**Knowledge and reasoning**: Knowledge based Agents, The Wumpus World, Propositional Logic, Agents Based on Propositional Logic, First Order Logic, Knowledge Engineering in First-Order Logic, Inference in FOL, Propositional vs. First-Order Inference, Forward chaining, Backward chaining, Unification and lifting, Resolution	**12**
4	**Planning:** Definition of Classical Planning, Algorithms for Planning as State-Space Search Planning Graphs, Hierarchical Planning, Planning and Acting in Nondeterministic Domain: Sensorless planning, Contingent planning, Online replanning.	**10**
5	**Uncertain Knowledge and Reasoning**: Uncertainty, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bayes' theorem, Belief Networks, Simple Inference in Belief Networks.	**06**
6	**Applications and subsets of AI**- examples of AI, robotics and AI, future of AI, applications of AI, Subsets of AI-expert systems, machine learning, NLP	**04**

Books Recommended:

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.
3. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Publication, July 2017.

Reference Books:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011.
2. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Sixth edition, Pearson Education,2009.

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Program: Third Year B.Tech. (Minor Program in AIML)	Semester: VI
Course: Machine Learning	Course Code: DJ19MN6C2
Course: Machine Learning Laboratory	Course Code: DJ19MN6L1

<table>
<tr><th colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</th><th colspan="8">Evaluation Scheme</th></tr>
<tr><th colspan="4">Semester End Examination Marks (A)</th><th colspan="3">Continuous Assessment Marks (B)</th><th>Total marks (A+ B)</th></tr>
<tr><th rowspan="3">Lectures</th><th rowspan="3">Practical</th><th rowspan="3">Tutorial</th><th rowspan="3">Total Credits</th><th colspan="3">Theory</th><th>Term Test 1</th><th>Term Test 2</th><th>Avg.</th><th></th></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">150</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">5</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of data structures, basic probabilities and statistics, AI.

Course Objectives: The course will introduce students to the basic concepts and techniques of Machine Learning. It will familiarize students with regression, clustering, classification and SVM techniques.

Course Outcomes: On completion of the course, learner will be able to:

1. Apply machine learning techniques for a given problem

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Machine Learning:** Terminologies in machine learning, Types: supervised, unsupervised, semi-supervised learning**,** Issues in Machine Learning, Application of Machine Learning, Steps involved in developing a Machine Learning Application, Hypothesis, and Inductive Bias.	**08**
2	**Regression:** Least Square Regression, Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Prediction Model, probabilistic interpretation, Regularization, Logistic regression, multi class classification, Linear Discriminant Analysis.	**12**
3	**Decision Tree:** Definitions, Supervised Learning of Univariate Decision Tree, Attribute Selection Measures, Multiway Splits and binary splits, Regression Trees (CART), Overfitting and Evaluation, Stopping Criterion & Pruning loss functions, Model Evaluation and Selection	**12**
4	**Bayes Decision Theory:** Bayes decision rule, Minimum error rate classification, Normal density, and discriminant functions. Parameter Estimation: Maximum Likelihood and Bayesian Parameter Estimation Ensemble Models: Introduction to Ensemble Methods, Bagging, Boosting, Random forests, Improving classification accuracy of Class-Imbalanced Data.	**08**

5	**Clustering:** Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering, Gaussian mixture model.	**08**
6	**Support Vector Machine:** Linear learning machines and Kernel space, Making Kernels and working in feature space SVM for classification and regression problems. Evaluation Measures: Bootstrapping & Cross Validation, Class Evaluation Measures, The ROC Curve Minimum Description Length & Exploratory Analysis.	**04**

Books Recommended:

Text Books

1. Tom M.Mitchell, "Machine Learning", 1st edition, McGraw Hill Education, 2017.
2. Peter Harrington, "Machine Learning in Action", 1st Edition, DreamTec Press, 2012.
3. Ethem Alpaydın, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014.
4. Kevin P Murphy, "Machine Learning a probabilistic perspective", Illustrated edition, The MIT Press, 2012.

Reference Books

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 2nd Edition, The MIT Press, 2012.
2. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", 1st Edition, O'reilly, 2016.
3. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, CRC Press, 2014.
4. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques", 3rd Edition Morgann Kaufmann Publishers, 2011.

Online References

1. "NPTEL course on Introduction to Machine Learning by Prof. Balaraman Ravindran", https://nptel.ac.in/courses/106106139 (accessed Dec 16, 2022)
2. "NPTEL course on Machine Learning by Prof. Carl Gustaf Jansson, Prof. Henrik Bostrom, Prof. Fredrik Kilander", https://nptel.ac.in/courses/106106202 (accessed Dec 16, 2022)
3. "NPTEL course on Introduction to Machine Learning by By Prof. Sudeshna Sarkar", https://onlinecourses.nptel.ac.in/noc22_cs97/preview (accessed Dec 16, 2022)
4. "Coursera course on Supervised Machine Learning", https://www.coursera.org/learn/machine-learning (accessed Dec 16, 2022)

Suggested List of Experiments:

1. Perform Linear Regression.
2. Perform Logistic Regression.
3. Perform Decision Tree.
4. Perform Ensemble methods.
5. Perform Bayesian Classification.
6. Perform Support Vector Machine.
7. Perform K-means clustering.
8. Analyze performance measures.

Prepared by Checked by Head of the Department Principal

Program: Final Year B. Tech Electronics, Chemical and Mechanical Engineering (Minors)	Semester: VII
Course: Deep Learning	Course Code: DJ19MN6C3
Course: Deep Learning Laboratory	Course Code: DJ19MN6L2

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total Mark (A+B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work			
4	2	--	5	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal	Total Term work	50
				25	--	--	15	10	25	

Pre-requisite: --

1. Machine Learning

The objective of this course is

To familiarize students with the concept of deep learning and to enable them to assimilate to different types of neural networks. The course also aims to expose students to the idea of auto encoders and GANs.

Outcomes: On completion of the course, the learner will be able to:

1. Understand the deep learning and its concepts.
2. Interpret working of different types of neural networks.
3. Choose the suitable deep learning architecture for various real-world applications.

Deep Learning (DJ19MN6C3)		
Unit	**Description**	**Duration**
1	**Fundamentals of Deep Learning** Getting started with Neural Network, Fundamental concepts of Biological Neural Network, Perceptron, Multilayer feed-forward network, Terminologies in Deep Learning: weight, bias, threshold, Activation functions, loss functions	08
2	**Deep Networks** Cost functions, Optimizations: Gradient descent, learning rate, batch size and stochastic gradient descent, Tuning hidden layer count and neuron count, Exploding gradient and vanishing gradient, Avoiding overfitting through model generalization, Fancy optimizers, Hyperparameters	10

3	**Artificial Neural Network** Artificial Neural Network, Dense Networks, Feedforward and Feedback propagation McCulloch Pitts Neuron: Theory and Architecture; Linear separability; Hebb Network: Theory and Algorithm. ANN with backpropagation.	08
4	**Convolutional Neural Network** Introduction to CNNs, Kernel filter, Stride, Padding, Principles behind CNNs, Multiple Filters, CNN applications. **ConvNet Architectures**: AlexNet, VGG, GoogLeNet, ResNet.	08
5	**Recurrent Neural Networks** Introduction to Sequence Models and Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs: Unfolded RNNs, Seq2Seq RNNs, Long Short-Term Memory (LSTM), BERT, Bidirectional RNN, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), RNN applications.	10
6	**Auto Encoders and Adversarial Networks** Auto encoders (standard, denoising, contractive, etc.), Variational Autoencoder, Introduction to Adversarial Networks, Generative Adversarial Networks, Applications of Adversarial Networks.	08
	Total	**52**

List of Practicals:

1. To build a Neural Network for the given problem.
2. To perform Image captioning using Convolutional Neural Network.
3. To perform Image classification using Convolutional Neural Network.
4. To perform image classification like digit identification using LSTM
5. Sentiment Analysis using LSTM
6. Implement Recommendation system using LSTM
7. Text Summarization using BERT
8. Fake news detection using BERT
9. To implement EBPTA for the given problem.
10. Text Prediction/ Language Translators using Recurrent Neural Network
11. Implementation of Generative Adversarial Networks
12. Mini Project

Books Recommended:

Text books:

1. John Krohn, Grant Beyleveld, and Aglae Bassens, “Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”, Pearson, 2022
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018
3. Josh Patterson, Adam Gibson, “Deep Learning”, O'Reilly Media, Inc., August 2017
4. Umberto Michelucci, “Advanced Applied Deep Learning: Convolutional Neural Networks and Object Detection” Apress, 2019
5. Simon Haykin, “Neural Networks and Learning Machines”, Pearson Prentice Hall, 3rd Edition, 2010.

Reference Books:

1. Yegnanarayana, B., “Artificial Neural Networks”, PHI Learning Pvt. Ltd, 2009.
2. Satish Kumar, “Neural Networks: A Classroom Approach”, Tata McGraw-Hill Education, 2004.
3. Raúl Rojas, “Neural networks: A Systematic Introduction”, Springer Science & Business Media, 2013
4. David Foster, “Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play”, O’Reilly Media, 2019

Online Resources:

1. NPTEL:
   Deep Learning, By Prof. Prabir Kumar Biswas, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc22_cs22/preview
2. Coursera:
   Deep Learning Specilization, By DeepLearning.AI
   https://www.coursera.org/specializations/deep-learning#course
3. ANN Virtual Lab:
   http://cse22-iiith.vlabs.ac.in/List%20of%20experiments.html

Program: Final Year B.Tech. (Minor Program in AIML)										Semester: VIII			
Course: Natural Language Processing										Course Code: DJ19MN6C4			
Teaching Scheme (Hours / week)				Evaluation Scheme									
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)						Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2		Avg.			
				75			25	25		25			100
				Laboratory Examination			Term work			Total Term work			-
4	-	--	4	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal					
				-	--	--	-	-		-			

Pre-requisite: Knowledge of Artificial Intelligence and Python Programming

Course Objectives: To understand natural language processing and its basic algorithms for solving real world problems. To get acquainted with the basic concepts and algorithmic description of the main language levels- morphology, syntax, semantics, and pragmatics. To familiarize learners with various language models.

Course Outcomes: On completion of the course, learner will be able to:

1. Understand NLP techniques for real world problems.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction:** Origin & History of NLP, Stages in NLP, Ambiguities, and its types in English and Indian Regional Languages; Applications of NLP- Machine Translation, Information Retrieval, Question Answering System, Sentiment Analysis, Text Categorization, Text Summarization, Named Entity Recognition.	06
2	**Word Level Analysis:** Inflectional Morphology, Derivational Morphology, Regular expression with types, Morphological Models: finite state morphology, Morphological parsing with FST (Finite State Transducer), Lexicon free FST Porter Stemmer algorithm, Grams and its variation: Bigram, Trigram, Simple (Unsmoothed) N-grams; N-gram Sensitivity to the Training 9 Corpus, Evaluating N-grams: Perplexity, smoothing: Laplace Smoothing, Good-Turing Discounting	12
3	**Syntax Analysis:** Part-Of-Speech tagging (POS), Tag set for English (Upenn Treebank), Difficulties /Challenges in POS tagging, Rule-based, Stochastic and Transformation-based tagging, Generative Model: Hidden Markov Model (HMM Viterbi) for POS tagging; Issues in HMM POS tagging, Discriminative Model: Maximum Entropy model, Conditional random Field (CRF)	12

4	**Semantics and Discourse Analysis**: Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babelnet. Attachment for fragment of English, Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy, Semantic Ambiguity, Word Sense Disambiguation (WSD), Knowledge based approach (Lesk's Algorithm), Supervised (Naïve Bayes, Decision List).	**08**
5	**Pragmatic & Discourse Processing Discourse:** Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence, Anaphora Resolution using Hobbs and Cantering Algorithm, Discourse segmentation, Conference resolution	**06**
6	**Computational tools for text analysis**: Tokenization, Stemming, Lemmatization, Natural Language Toolkit (NLTK): Corpora and other data resources, Uses of corpora: Lexicography, Grammar and syntax, Stylistics, Training, and evaluation. Basic corpus analysis: Frequency distribution building and analyzing a corpus. Tokenization in the NLTK, Tokenizing text	**08**

Books Recommended:

Textbooks:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson, 2014.
2. Raymond S. T. Lee, "Natural Language Processing: A Textbook with Python Implementation", First Edition, 2023.
3. Eisenstein, Jacob, "Introduction to Natural Language Processing. United Kingdom", MIT Press, 2019.
4. Ghosh, Sohom., Gunning, Dwight. "Natural Language Processing Fundamentals: Build Intelligent Applications that Can Interpret the Human Language to Deliver Impactful Results". United Kingdom: Packt Publishing, 2019.
5. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
6. Ashish Bansal, "Advanced Natural Language Processing with TensorFlow 2: Build effective real-world NLP applications using NER, RNNs, seq2seq models, Transformers, and more", Packt Publishing, 2021.

Reference Books:

1. Manning, Christopher, and Hinrich Schutze, "Foundations of statistical natural language processing. MIT press,1997.
2. Daniel M Bikel and Imed Zitouni ― Multilingual natural language processing applications‖ Pearson, 2013.
3. D. Jurafsky, and J. Martin, Speech and language processing: an introduction to natural language processing, computational linguistics, and speech recognition, Pearson Prentice Hall, Second Edition (2013).

Online References

1. "NPTEL course on Natural Language Processing by Prof. Pawan Goyal", https://onlinecourses.nptel.ac.in/noc19_cs56/ (accessed Dec 6, 2023)

Prepared by Checked by Head of the Department Principal