FACULTY OF ENGINEERING & TECHNOLOGY

BACHELOR OF ENGINEERING

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (DRAFT SYLLABUS)

Course Structure

Sr. No.	Semester	Temp. Course Code	Course Title	L	T	P	Credits
1.	3	AIML-1	Artificial Intelligence	3	0	2	4
2.	4	AIML-2	Machine Learning	3	0	2	4
3.	5	AIML-3	Deep Learning	3	0	2	4
4.	6	AIML-4	Soft Computing	3	0	2	4
5.	6	AIML-5	Mini-project	0	0	4	2
TOTAL				12	0	12	18

Detailed Syllabus

Course code:	**AIML-1**
Name of the course:	**Artificial Intelligence**
Semester:	**3**
Category of Course:	**AIML**

Course objectives:

The objective of this course is to present an overview of the principles and practices of AI to address real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

Teaching & Examination Scheme:

Teaching Scheme			Credits	Examination Marks(Maximum/Passing)		Total
				External		
L	T	P	C	ESE(T)	ESE(P)	
3	0	2	4	50/25	50/25	100/50

ESE(T): End Semester Examination(Theory)

ESE(P): End Semester Examination(Practical)

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Course Contents:

Unit	Contents	Hours
1	Introduction to Artificial Intelligence: Overview, Turing test, Applications	2
2	Problem Solving by Search: Importance of search in AI, State space search, Problem characteristics, Heuristic search: Hill climbing, Best first search and A*, Problem Reduction& AO*, Constraint satisfaction, Mean Ends Analysis	8
3	Knowledge Representation and Reasoning: Propositional logic, Reasoning with propositional logic, Predicate Logic, Reasoning with first order logic; Forward reasoning, Backward reasoning	7
4	Reasoning under Uncertainty: Bayes theorem, Bayesian networks, Overview of Fuzzy logic& Fuzzy Reasoning	4
5	Game Playing, Planning, NLP and Applications Minimax algorithm, Alpha-beta pruning, Introduction to planning, Goal stack planning, Introduction to Natural Language Processing, Applications of AI in Health care, Smart Cities, Agriculture, Robotics, etc.	9

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15%	25%	20%	15%	15%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Artificial Intelligence – a modern approach.By Stuart Russell and Peter Norvig(Pearson)
2. Nils J Nilsson, Principles of Artificial Intelligence, Illustrated Reprint Edition, Springer Heidelberg, 2014.
3. Artificial Intelligence.By Kevin Knight, Elaine Rich, and Shivashankar B. Nair (3rd Edition, McGraw Hill Education)
4. Artificial Intelligence by Example. By Denis Rothman (Packt)

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5. Artificial Intelligence and Machine learning. By Vinod Chandra S.S. and AnandHarindran S. (PHI)
6. A First course in Artificial Intelligence. By Deepak Khemani (McGraw Hill Education)
7. Introduction to Computation and Programming Using Python. By John V Guttag(PHI)

Course Outcomes (CO):

Sr. No.	Course Outcome Statements	% weightage
1	Understand problem solving through search and game playing techniques.	30
2	Use various knowledge representation methods for AI problem solution.	30
3	Understand basics of Natural Language processing.	10
4	Understand the various data structures available in Python and apply them in solving computational problems.	30

List of Practicals/Tutorials:

1. Introduction to Python & basic programming.
2. Write programs to understand the control structures of python
3. Develop programs to learn different types of structures (list, dictionary, tuples) in python.
4. Study of recursion in Python.
5. Develop programs for searching, sorting using python.
6. Learn to plot different types of graphs using PyPlot.
7. Implement Breadth first search or Depth first search.
8. Implementation of Best first search.
9. Solving 8-puzzle problem using python.
10. Write python program to solve puzzles (e.g.Sudoku, N-queen, cryptarithmatic).
11. Solving Travelling Salesman Problem using Python.
12. Implement text tokenization using python.

Supplementary Learning Material:

1. SwayamNPTEL course on Fundamentals of Artificial Intelligence: **https://onlinecourses.nptel.ac.in/noc21_ge20/preview**
2. SwayamNPTEL course on Introduction to Artificial Intelligence:**https://onlinecourses.nptel.ac.in/noc21_cs42/preview**

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Course Articulation Matrix:

CO	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 13	PSO 14	PSO 15
1	CO1	2	2	3	-	-	-	-	-	-	-	-	1	2	2	2
2	CO2	2	3	3	2	2	1	-	-	-	1	-	2	1	2	1
3	CO3	1	2	2	2	2	2	-	-	-	2	-	2	1	2	1
4	CO4	2	2	3	2	3	-	-	-	-	-	-	2	2	2	2

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High) '–' No correlation

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Detailed Syllabus

Course code:	**AIML-2**
Name of the course:	**Machine Learning**
Semester:	**4**
Category of Course:	**AIML**

Course objectives:
This course introduces the concept of learning from data and develop a strong foundation for understanding important Machine Learning algorithms and their applications mainly regression, classification and clustering.

Teaching & Examination Scheme:

Teaching Scheme			Credits	Examination Marks(Maximum/Passing)		Total
				External		
L	T	P	C	ESE(T)	ESE(P)	
3	0	2	4	50/25	50/25	100/50

ESE(T): End Semester Examination(Theory)

ESE(P): End Semester Examination(Practical)

Course Contents:

Unit	Contents	Hours
1	Introduction to Machine Learning: Overview of Machine learning, Types of Learning, Applications of Machine	2

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	Learning	
2	Classification: Overview of classification, K-Nearest neighbor, Bayesian classification, Decision tree based classification, Neural Networks: Overview, Architectures, Perceptron and backpropagation, Introduction to Support Vector machine, Applications of classification	12
3	Regression Analysis: Introduction to regression, Correlation, Linear regression, Multiple linear regression, Applications of regression	8
4	Clustering: Introduction to clustering, Types of clustering methods, K-means, K-medoids, Issues with clustering, Applications of clustering	4
5	Evaluation Measures, Ensemble methods, Introduction to Reinforcement learning: Overview and Applications	4

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	30%	25%	15%	15%	5%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Machine Learning. By Tom M Mitchell (McGraw Hill)
2. Machine learning – a practitioner's approach. By Vinod Chandra S.S. and AnandHarindran S. (PHI)
3. Machine learning with Python for Everyone. By Mark Fenner (Person)
4. Pattern Classification. Richard O. Duda, Peter E. Hart, David G. Stork(John Wiley & Sons Inc.)

Course Outcomes (CO):

Sr. No.	**Course Outcome Statements**	**% weightage**
1	Understand basic concepts of learning from data and various types of learning.	20
2	Apply supervised learning techniques like classification and regression for real-time problems.	40

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3	Understand and apply clustering techniques.	20
4	Identify and optimize parameters of various machine learning techniques.	20

List of Experiments/Tutorials:

1. Study of machine learning library in Keras.
2. Write a python code to implement K-nearest neighbourhood program for the given dataset.
3. Write a python code to implement decision tree for a given dataset.
4. Write a python code to apply Naive Bayesian algorithm to classify a dataset from UCI/Kaggle.
5. Write a program to implement perceptron. Test for OR Gate, AND Gate and XOR Gate.
6. Implement Neural networks using Keras.Test to classify breast tumour data into malignant breast tumour or benign breast tumour (use breast tumour dataset) and obtain its accuracy level.
7. Study of Linear Regression with Excel.
8. Write a python code for prediction using linear regression model. Test with suitable dataset.
9. Write a python program to build an email spam classifier using support vector machines for the Spam base dataset from UCI machine learning repository.
10. Write a python program to perform clustering using python. Test with suitable dataset.
11. Study of WEKA tool for Preprocessing and Visualization.
12. Use WEKA tool for Classification and Clustering.

Supplementary Learning Material:

1. Swayam NPTEL course on Machine Learning: https://onlinecourses.nptel.ac.in/noc21_cs70/preview

Course Articulation Matrix:

CO	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 13	PSO 14	PSO 15
1	CO1	2	1	-	-	-	-	-	-	1	1	-	2	2	1	-
2	CO2	3	3	3	2	3	2	-	1	2	2	-	2	-	2	3
3	CO3	2	3	3	2	3	2	-	-	2	2	-	2	1	1	2
4	CO4	2	3	-	-	3	-	-	-	-	-	-	2	-	1	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High) '–' No correlation

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Detailed Syllabus

Course code:	**AIML-3**
Name of the course:	**Deep Learning**
Semester:	**5**
Category of Course:	**AIML**

Course objectives: The course is aimed to learn various deep learning techniques and use them for real-time applications like image classification, object recognition, text processing, etc.

Teaching & Examination Scheme:

Teaching Scheme			Credits	Examination Marks(Maximum/Passing)		Total
				External		
L	T	P	C	ESE(T)	ESE(P)	
3	0	2	4	50/25	50/25	100/50

ESE(T): End Semester Examination(Theory)

ESE(P): End Semester Examination(Practical)

Course Contents:

Unit	Contents	Hours
1	Introduction to deep learning: Overview, Machine learning vs. deep learning, applications of deep learning, feature engineering, overview of Deep learning frameworks, Shallow networks vs. Deep learning	3
2	Convolutional Neural Networks: Review of Neural Networks, Introduction to Convolutional Neural Networks, Building blocks of CNN: convolution, activation function, pooling, dropout, regularization, fully-connected, Optimizers; Pre-trained CNN models, Transfer Learning, Applications of CNN, Variants of CNN	10
3	Recurrent Neural Networks: Introduction to Recurrent Neural Networks, Long-Short Term Memory, Gated Recurrent Unit, Sequential models,vanishing gradients, Applications of RNN.	8
4	Advanced Concepts and Architectures: Deep Autoencoders, Generative Models with Adversarial Learning	6
5	Case-study Applications: Image classification, Object recognition, Vehicle classification, Character/digit recognition, ImageCaptioning, Language Modeling, etc.	3

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Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	25%	30%	15%	10%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Deep Learning. Ian Goodfelllow,YoshuaBenjio, Aaron Courville(The MIT Press)
2. Deep Learning with Python. By Francois Chollet
3. Patterson and Gibson, Deep Learning, O'reilly
4. Antonio Gulli, Sujit Pal, Deep learning with keras.

Course Outcomes (CO):

Sr. No.	Course Outcome Statements	% weightage
1	Understand basic concepts of deep learning and CNN.	25
2	Apply neural networks and CNN for various problems of computer vision and other domains	30
3	Optimize parameters for better outputs.	20
4	Understand basic concepts of RNN and LSTM and apply them to solve problems.	25

List of Practicals/Tutorials:

1. Study of Deep learning tools and library. (Keras, Tensorflow, Pytorch,etc.)
2. Demo of neural networks through playground.tensorflow.org
3. Implementation of Neural Networks using Keras.
4. Perform MNIST data classification using CNN.
5. Perform CIFAR-10 data classification using CNN any one pretrained model.
6. Apply transfer learning with any one CNNpretrained model. Test on CIFER-10 data.
7. Apply YOLO for object detection from image/video.
8. Study and Implementation of RNN.
9. Study and Implementation of LSTM.
10. Study and Implementation of GRU.
11. Perform Text Preprocessing using Python (tokenization, lemmatization and stemming, POS tagging, etc.)
12. Perform text classification using RNNs.

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Supplementary Learning Material:

1. **Swayam NPTEL course: Deep Learning**
   https://onlinecourses.nptel.ac.in/noc20_cs11/preview
2. **Swayam NPTEL course: Deep Learning for Visual Computing**
   https://onlinecourses.nptel.ac.in/noc20_ee74/preview
3. **machinelearningmastery.com**
4. **towardsdatascience.com**

Course Articulation Matrix:

CO	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 13	PSO 14	PSO 15
1	CO1	2	2	2	2	3	1	-	-	-	-	-	2	1	1	2
2	CO2	3	3	3	2	3	1	-	1	2	2	1	2	-	2	2
3	CO3	2	2	2	2	2	-	-	-	-	-	-	2	1	-	1
4	CO4	2	3	3	3	3	-	-	-	2	2	1	2	-	2	2

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High) '–' No correlation

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Detailed Syllabus

Course code:	**AIML-4**
Name of the course:	**Soft Computing**
Semester:	**6**
Category of Course:	**AIML**

Course objectives: The objective of the course is to learn concepts and working of various soft computing techniques such as genetic algorithms, fuzzy logic and neural networks and apply them for various real-time engineering problems such as classification, optimizations, clustering and controls.

Teaching & Examination Scheme:

Teaching Scheme			Credits	Examination Marks(Maximum/Passing)		Total
				External		
L	T	P	C	ESE(T)	ESE(P)	
3	0	2	4	50/25	50/25	100/50

ESE(T): End Semester Examination(Theory)

ESE(P): End Semester Examination(Practical)

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Course Contents:

Unit	Contents	Hours
1	Introduction to Soft Computing: Overview of Soft computing, Soft computing vs Hard computing, Introduction to fuzzy systems, genetic algorithm, neural networks	**2**
2	Fuzzy Logic: Introduction to fuzzy logic, fuzzy membership functions, operators on fuzzy sets, fuzzy relations, fuzzy inference, defuzzyfication techniques, fuzzy logic controller	8
3	Genetic Algorithm: Optimization problem, Concept of GA, GA operators – selection, crossover, mutation, applications of genetic algorithms, Evolutionary computation, Multiobjective Evolutionary Algorithms	8
4	Artificial Neural Networks (ANN): Introduction to ANN, architecture, perceptron, feedforward with backpropagation, Parameters of ANN, Applications of ANN	8
5	Hybrid Systems: Neuro-fuzzy systems, Neuro-GA systems, Fuzzy-GA Systems, Applications of hybrid systems	4

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	20%	30%	15%	15%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Soft computing: Fundamentals and Applications, By D K Pratihar (Alpha Science)
2. Principles of Soft Computing, By S.N.Sivanandam, S.N.Deepa (Wiley India Pvt. Ltd)
3. Fuzzy Logic with Engineering Applications, By Timothy J. Ross (Wiley)
4. Neural Networks and Learning Machines, By Simon Haykin (PHI)
5. Genetic Algorithms in Search, Optimization and Machine Learning, By David E Goldberg (Pearson Education India)
6. Neural Networks, Fuzzy systems, and Genetic algorithms: Synthesis and Applications. By S. Rajasekaran, and G. A. VijayalakshmiPai (PHI)

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Course Outcomes (CO):

Sr. No.	Course Outcome Statements	% weightage
1.	Understand and apply Neural Network for various applications.	20
2.	Develop Fuzzy Inference System for various applications.	30
3.	Apply genetic algorithms for optimization problems.	30
4.	Apply hybridization of soft computing techniques for solving problems.	20

List of Practicals/Tutorials:

1. Study of fuzzy logic toolbox in MATLAB or Scilab.
2. Design fuzzy sets using Matlab for a given application.
3. Design a Fuzzy control system for robot movement.
4. Implementation of perceptron learning algorithm.
5. Study of Neural Network toolbox in MATLABor Scilab.
6. IRIS data classification using neural networks.
7. Application of neural networks for regression dataset.
8. Study of Pattern Recognition tool in MATLAB.
9. Study of Genetic algorithm toolbox in MABLAB or Scilab.
10. Implement/use genetic algorithm for a given optimization problem
11. Perform parameter tuning with Genetic algorithms.
12. Implementation of any project using Nerural networks or GA or fuzzy logic.

Supplementary Learning Material:

1. Swayam NPTEL course on Soft Computing: https://onlinecourses.nptel.ac.in/noc21_cs11/preview

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 13	PSO 14	PSO 15
CO1	3	3	3	2	3	1	1	-	-	1	1	2	2	2	2
CO2	3	3	3	2	3	1	1	-	-	1	1	2	2	2	2
CO3	3	3	3	2	3	1	1	-	-	1	1	2	1	1	1
CO4	2	3	3	3	3	1	1	-	-	1	1	2	1	1	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High) '–' No correlation

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Detailed Syllabus

Course code:	**AIML-5**
Name of the course:	**Mini-project**
Semester:	**6**
Category of Course:	**AIML**

Course objectives:

The main objective of Mini Project is to let the students apply the knowledge of theoretical concepts which they have learnt as a part of the curriculum of the minor degree using real time problems or situations.

Teaching & Examination Scheme:

Teaching Scheme			Credits	Examination Marks(Maximum/Passing)		Total
				External		
L	T	P	C	ESE(T)	ESE(P)	
0	0	4	2	00	100/50	100/50

ESE(T): End Semester Examination(Theory)

ESE(P): End Semester Examination(Practical)

Course Guidelines:

- The mini-project is desirable to be done in a group of 2 students. Each group has to prepare a title related to any engineering discipline, and the title must emulate any real-world problem.
- Submit an early proposal. This proposal is a 1-2page(s) report, describes what the project is about and the final product's output. The project proposal will be submitted to the respective guide.

Course Outcomes (CO):

- Understand, plan and execute a Mini Project with team.
- Students will be able to practice acquired knowledge within the chosen area of technology for project development.
- Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
- Communicate and report effectively project related activities and findings.

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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7.Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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11.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Ability to conceptualize interdisciplinary domain knowledge to specific branch of engineering.
2. Ability to acquire employability skills and deep knowledge in emerging and multidisciplinary areas.
3. Carryout engineering projects in broad areas of engineering.

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