Course Title	**Application of Artificial Intelligence in Electrical Engineering**
Course Code	**EE 5305**
No. of Credit Hrs (Lecture + Tutorial + Lab)	**3 (2+0+1)**
No. of Contact Hrs (Lecture + Tutorial + Lab)	**4 (2+0+2)**
Level-Year	**9-5**
Prerequisite (if any)	**STAT 1211, EE3302**

1. Course Objectives:

To familiarize with the concept of Artificial Intelligence, fuzzy logic, artificial neural networks, optimization, machine learning and its applications in electrical engineering.

2. Expected Learning Outcomes:

1. **Recognize and describe** the fundamentals of Artificial Intelligence and its applications across various sectors. **PLO1 [1]**
2. **Apply and adapt** concepts of Machine Learning algorithms to solve engineering problems. **PLO9 [7]**
3. **Demonstrate and explain** fuzzy systems and fuzzy controllers for modeling and control of electrical systems. **PLO1 [1]**
4. **Design and implement** artificial neural networks for applications in different electrical engineering domains. **PLO2 [2]**
5. **Evaluate and justify** the role of AI-based approaches in solving modern engineering problems. **PLO5 [4]**

3. Course Contents

1. Introduction to Artificial Intelligence and Fuzzy Systems:
   Artificial Intelligence: Definition, scope and applications. Fuzzy Systems: Fuzzy sets and operations, membership functions, Fuzzification and Defuzzification, rule base, introduction to Fuzzy Logic Control, implementation in Electric Drives, Industrial Automation, Renewable Energy Systems, Electric Vehicles, Smart Grids etc.
2. Artificial Neural Networks:
   Introduction to Artificial Neural Networks, Biological Neuron, Artificial Neuron, Activation functions of Artificial Neuron, Structure of Artificial Neural Network, feed forward and recurrent Artificial Neural Networks, training of Artificial Neural Networks, Learning Methods, Back Propagation Algorithm, Implementation in Electric Drives, Industrial Automation, Renewable Energy Systems, Electric Vehicles, Smart Grids et.
3. Random Search Optimization:
   Modelling of the Optimization Problems, 1-D Optimization Algorithms (Bisection Method and Newton–Raphson Method), of operation, guided random search methods (Genetic Algorithm, Simulated Annealing, Particle Swarm Optimization), Implementation in Electric Drives, Industrial Automation, Renewable Energy Systems, Electric Vehicles, Smart Grids etc.
4. Machine Learning:
   Introduction to Machine Learning (ML), Types of ML (Supervised Learning, Unsupervised Learning, Reinforcement Learning & Evolutionary Learning), support vector regression, Support Vector Machine (SVM), Kernel SVM, Application in Electric Drives, Industrial Automation, Renewable Energy Systems, Electric Vehicles, Smart Grids etc.

4. Lab Content

1. Introduction to Artificial Neural Networks toolbox in MATLAB
2. Programming practice for Fitting a Function using ANN toolbox
3. Programming practice for Network Models, Network Architectures, Training Styles and Data structures using ANN toolbox
4. Programming practice for Control Systems using ANN toolbox
5. Programming practice for Descriptive Statistics and Visualization using Statistics and Machine Learning toolbox in MATLAB

6. Programming practice for Probability Distribution using Statistics and Machine Learning toolbox in MATLAB
7. Programming practice for Cluster Analysis using Statistics and Machine Learning toolbox in MATLAB
8. Programming practice for Regression using Statistics and Machine Learning toolbox in MATLAB
9. Application of Artificial Intelligence Techniques for the Control of the Asynchronous Machine using MATLAB

5. Teaching Methods:

- Lectures and Discussion
- Videos
- Self-learning
- Tutorial sheets

6. Mode of Evaluation: Course Assessment Methods

- Quizzes , Assignment, Homeworks, Reports, Presentations etc.
- Lab Work
- Mid Exam
- Final Exam

Evaluation

No	Assessment Activities *	Percentage
1.	Assignments/Quizzes/HomeWorks/Mini-Projects/Presentations/Reports+Quizzes	15%
2.	Mid Exam	25%
3.	Lab/Tutorial (Lab Exam)	10%
4.	Lab/Tutorial (Lab Reports)	10%
5.	Final Exam	40%

7. Textbook(s):

1. Saifullah Khalid, “Applications of Artificial Intelligence in Electrical Engineering, “Business Science Reference, 2020.
2. Mark Hudson BealeMartin T. HaganHoward B. Demuth, “Neural Network Toolbox™ 7 User’s Guide”, Mathworks Inc.

8. References:

1. T.J.Ross, “Fuzzy Logic with Engineering Applications,” 3rd edition, Wiley, 2011.
2. Simon S. Haykin, “Neural Networks – A Comprehensive Foundation,” Pearson Education, 1997.
3. Neural Network Design (2nd Edition) by Martin T Hagan (Author), Howard B Demuth (Author), Mark H Beale (Author), Orlando De Jesús (Author)