DEPARTMENT OF ELECTRICAL ENGINEERING

Subject Code: 01PEED0107

Subject Name: Artificial Intelligence in Electrical Engineering

MTech. Year – 1 (Semester – 1)

Objective: Artificial intelligence is gaining popularity every passing year because of its diverse applications in almost every engineering and social fields. Classical problems of detection, identification and creation can be tackled with the tools and techniques of artificial intelligence. Therefore the objective of the subject to

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Credits Earned: 4/5 Credits

Course Outcomes: After completion of this course, student will be able to

- Understand how the soft computing techniques can be used for solving the problems of power electronics and motor drives.
- Design of ANN based systems for function approximation in signal estimation for vector drives.
- Design of Fuzzy based systems for load frequency control in power systems.
- Develop and evaluate control systems required in operations of power electronics equipment.

Pre-requisite of course: Linear algebra, Calculous, and feel comfortable with computer language programming.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Term work (TW)	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction** • The AI Problems, The Underlying Assumption, What is An AI Techniques? • Difference between soft computing techniques and hard computing systems. • Expert systems brief history of ANN and Fuzzy Logic.	4
2	**Artificial Neural Network** • Introduction, • History of neural network research, • Basic concepts of Neural Networks, Human brain, • Model of Artificial Neuron, • Neural Network architectures, Perceptron, • Single layer feed forward Network, • Multi layer feed forward network, • Recurrent networks (RNN), Feedback networks and Radial Basis Function Networks • Characteristics of NN, Learning Methods, LMS and Back Propagation Algorithm, training Examples of models • Advances in Neural networks	10
3	**Deep Learning** • Convolution Neural Network (CNN): Neuron in human vision, Shortcoming of feature selection, Filters and feature maps, Full Description of Convolution neural network (CNN), Max pooling. • Principal component analysis • Autoencoder: Architecture, Sparsity. • Long short term memory units in RNN	8
4	**Fuzzy Logic** • Introduction, Comparison between Fuzzy and crisp logic, • Fuzzy sets, Membership function, Basic fuzzy set operations, • Properties of Fuzzy set, fuzzy relations, • Fuzzy interference system, Mamdani, Sugeno, Fuzzy rule based system, Defuzzification methods, Fuzzy Neural Networks	8
5	**Applications** • ANN in space vector PWM wave synthesis for 2-level and multi-level converters. • Static feedback signals estimation for a vector drive, space vector PWM for a two-level voltage-fed inverter and voltage model flux vector estimation. • Model referencing adaptive control (MRAC) of ac drives, drift-free flux estimation of drives. • Fuzzy logic based control replacing PID controller • Neuro-fuzzy control of drives.	10
	Total Hours	40

References:

1. Neural Networks, Fuzzy logic and Genetic algorithms By S. Rajasekaran, G. A. Vijayalakshmi Pai PHI publication,
2. Principles of Soft computing, Wiley, 2nd Edition, S. N. Deepa and S. Sivanandam.
3. Introduction to Neural Networks using MATLAB 6.0, McGraw Hill Education, S. Sivanandam, S. Sumathi, S. N. Deepa.
4. Neural Network: A Comprehensive Foundation, second edition, Pearson Prentice Hall, Simon Haykin.
5. Deep learning with python: A Hands-on Introduction, Apress, Nikhil Ketkar
6. Fundamentals of Deep Learning, O' Reilly, Nikhil Baduma Nicholas Locasio.
7. Artificial intelligence techniques in power systems by KEVIN WARWICK, ARTHUR EKWUE RAJ AGRAWA

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	10%	15%	30%	20%	30%

Suggested List of Experiments:

1. Introduction to MATLAB and various tool boxes.
2. Use of MATLAB tool box for ANN.
3. Use of MATLAB tool box for Fuzzy Logic.
4. Use of MATLAB tool box for Optimization.
5. Use of MATLAB Programming for implementing NN.
6. Use of MATLAB Programming for generating different types of activation functions in ANN
7. Use of MATLAB Programming for training and testing of ANN.
8. Use of MATLAB for load forecasting using ANN
9. Use of MATLAB to get familiar with the deep learning toolbox.
10. Use of MATLAB to train an test of the load forecasting with the
11. MATLAB program for generating different types of Fuzzy membership functions.
12. Use of MATLAB for DTC control using fuzzy logic approach.

Recommendation:

- Use MATLAB as software package to implement ANN for applications.
- Suggest MOOC course: NPTEL on Deep Learning, Machine Learning, Data Analysis, and Soft computing.

- B. K. Bose, “Neural network applications in power electronics and drives”, Distinguished Lecture in Texas A&M University, College Station, Texas, November 12, 2001.