

INSTITUTE	FACULTY OF TECHNOLOGY
PROGRAM	MASTER OF TECHNOLOGY in ELECTRICAL ENGINEERING
SEMESTER	1
COURSE TITLE	ARTIFICIAL INTELLIGENCE APPLICATION IN POWER ELECTRONICS
COURSE CODE	01PE1105
COURSE CREDITS	4

Objective:

- 1 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 introduce learner to different AI techniques applied in power electronics application and their implementation.

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

- 1 Solve the problems of power electronics and motor drives with the help of AI techniques.
- 2 Design of ANN based systems for function approximation in signal estimation for vector drives.
- 3 Design of Fuzzy based systems for control of power electronic converter-based system.
- 4 Develop and evaluate control systems required in operations of power electronics equipment.

Pre-requisite of course:None

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction The AI Problems, The Underlying Assumption, Introduction to AI Techniques, Difference between soft computing techniques and conventional computing systems, Expert systems, Brief history of ANN and Fuzzy Logic	4

Contents : Unit	Topics	Contact Hours
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, haracteristics of NN, Learning Methods, LMS and Back Propagation Algorithm, training Examples of models	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	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, Fuzzy logic based controller for speed control application, Neuro-fuzzy control of drives	10
Total Hours		40

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment No. 01 Introduction to Artificial Neutral Network tool.	2
2	Experiment No. 02 Apply ANN tool for obtaining the output of a system.	2
3	Experiment No. 03 Apply Fuzzy Logic for determining the output based on set of inputs in power electronic converter.	2
4	Experiment No. 04 Perform optimization of parameters of power electronic converter using optimization technique.	2
5	Experiment No. 05 Use of MATLAB Programming for generating different types of activation functions in ANN	2
6	Experiment No. 06 Implement Neuro-Fuzzy controller for power electronic converter control.	2
7	Experiment No. 07 Use of AI for fault classification in the drive	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
8	Experiment No. 08 Apply Deep Learning for the categorization of Power Quality events in power systems.	2
9	Experiment No. 09 Case Study	4
Total Hours		20

Textbook :

- 1 Neural Networks, Fuzzy logic and Genetic algorithms, S. Rajasekaran, G. A. Vijayalakshmi, PHI publication, -
- 2 Principles of Soft computing, S. N. Deepa and S. Sivanandam, Wiley, 2nd Edition, -
- 3 Introduction to Neural Networks using MATLAB 6.0, S. Sivanandam, S. Sumathi, S. N. Deepa, McGraw Hill Education, -

References:

- 1 Neural Network: A Comprehensive Foundation, second edition, Neural Network: A Comprehensive Foundation, second edition, Simon Haykin, Pearson Prentice Hall, -
- 2 Deep learning with python: A Hands-on Introduction, Deep learning with python: A Hands-on Introduction, Nikhil Ketkar, Apress, -
- 3 Fundamentals of Deep Learning, Fundamentals of Deep Learning, Nikhil Baduma Nicholas Locasio, O' Reilly, -
- 4 Artificial intelligence techniques in power systems, Artificial intelligence techniques in power systems, Kevin Warwick, Arthur Ekwue Raj Agrawa, -, -

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as 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 / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
5.00	10.00	15.00	30.00	20.00	20.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and classroom.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Instructional Method:

- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

- 1 <https://nptel.ac.in/courses/106102220>