

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07)

ARTIFICIAL INTELLIGENT APPLICATION TO POWER SYSTEM

SUBJECT CODE: 2720719

SEMESTER: II

Type of course: Engineering

Prerequisite: Basic concepts and principles of Power Systems Analysis.

Rationale: This course provides detailed concepts of various soft computing techniques which can be useful in solving the problems of power systems engineering. Applications related to function approximation, control of frequency/voltage and power system optimization will be covered.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	0	4	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction Introduction, definition of AI difference between soft computing techniques and hard computing systems, expert systems brief history of ANN, Fuzzy and GA.	04	10
2	Artificial Neural Networks Introduction, History of neural network research, Basic concepts of Neural Networks, Human brain, Model of Artificial Neuron, Neural Network architectures, Single layer feed forward Network, Multi layer feed forward network, recurrent networks, characteristics of NN, Learning Methods Perceptron, ADALINE MADALINE Networks. Architecture of Back propagation Network, Non linear activation operators, single and multilayer ANN, learning methods like Back propagation, LM etc. training and testing of ANN.	10	20
3	Fuzzy Logic Introduction, Comparison between Fuzzy and crisp logic, Fuzzy sets, Membership function, Basic fuzzy set operations, properties of Fuzzy set, fuzzy relations, Fuzzy inference system, Mamdani, Sugeno, Fuzzy rule based system, defuzzification methods.	08	20
4	Genetic Algorithm Working principles, difference between GA and traditional methods, Different types of coding methods, fitness function, different types GA operators 1. Roulette wheel selection 2. Stochastic remainder Roulette wheel selection, Rank selection, Tournament selection and stochastic universal sampling, different types of cross over methods in GA,	10	20

	Mutation, Schema theorem, elite preserving operator, GA's for constrained optimization, understating of working of GA using flow chart.		
5	Applications of ANN, Fuzzy logic and GA in power systems operation and control for solving problems of load forecasting, voltage control, voltage stability, security assessment, feeder load balancing, AGC, Economic load dispatch, Unit commitment. Condition monitoring.	12	30

Reference Books:

1. Neural Networks, Fuzzy logic and Genetic algorithms By S. Rajasekaran, G. A. Vijayalakshmi Pai PHI publication,
2. Optimization for Engineering Design by Kalyanmoy Deb PHI publication
3. Multi-objective Optimization using Evolutionary Algorithms By Kalyanmoy Deb Willey Publication
4. Artificial intelligence techniques in power systems by KEVIN WARWICK, ARTHUR EKWUE RAJ AGRAWAL

Students are encouraged to read various research papers of peer reviewed journals for application related topics

Help Available in MATLAB

Course Outcome:

After learning the course the students should be able to:

1. Understand how the soft computing techniques can be used for solving the problems of power systems operation and control.
2. Design of ANN based systems for function approximation used in load forecasting.
3. Design of Fuzzy based systems for load frequency control in power systems
4. Solve problem of Optimization in power systems.

List of Suggested Tutorials:

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. MATLAB program for generating different types of Fuzzy membership functions.
10. Use of MATLAB for feeder load balancing problem by fuzzy logic.
11. MATLAB program for solving standard benchmark functions using Genetic algorithm.
12. MATLAB program for solving economic load dispatch problem using GA.

Students may use other softwares such as C, C++ etc in lieu of MATLAB

Major Equipment:

Computers.

List of Open Source Software/learning website:

MATLAB Software. C, C++, SCILAB

NPTEL courses related to power system analysis and Soft Computing

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.