GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29)

SOFT COMPUTING TECHNIQUES FOR INTELLIGENT CONTROL

SUBJECT CODE: 2712911

SEMESTER: I

Type of course: Major Elective-I

Prerequisite: Control Engineering

Rationale: This subject provides an overview of Soft computing techniques, which is an area of artificial intelligence research focused on the design of intelligent systems to process uncertain, imprecise, incomplete information. Soft computing methods applied to real world problems offer more robust, tractable and less costly solutions than those obtained by more conventional mathematical techniques

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2	2	5	70	30	20	10	20	0	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction:** Introduction to Soft Computing, Importance of Soft Computing, Main Components of Soft Computing, Fuzzy Logic, Artificial Neural Networks, Introduction to Evolutionary Algorithms, Hybrid Intelligent Systems.	5	10
2	**Artificial Neural Networks:** Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts Neuron model, simple perception, Adeline and Madeline, Feed-forward Multilayer Perception. Learning and Training the neural network .Hopfield network, Self-organizing network and recurrent network. Neural Network controller Application.	11	25
3	**Fuzzy Logic System:** Introduction of Fuzzy Logic, fuzzy sets. Basic fuzzy set operation and Properties of fuzzy sets, Introduction to fuzzy logic modeling and control- Fuzzification- inferencing and de-fuzzification-Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system	11	25
4	**Genetic algorithm:** History of Genetics, Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and and-colony search techniques for	8	20

	solving optimization problems.		
5	**Applications:** Application of GA to power system optimization problem, Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems- Implementation of fuzzy logic controller using Matlab- fuzzy logic toolbox-Stability analysis of fuzzy control systems.	7	20

Reference Books:

1. Devendra K. Chaturvedi, "Soft Computing Techniques and its Applications in Electrical Engineering", Springer.
2. S.N.Sivanandam, S.N.Deepa" Principles of Soft Computing"Wiley India Pvt.Ltd.
3. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999
4. KOSKO, B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India PvtLtd., 1994.
5. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.
6. David Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
7. N.P.Padhi,"Artificial Intelligence and Intelligent Systems", Oxford University Press

Course Outcome:

After learning the course the students should be able to:

1. To provide an understanding of the soft computing field
2. To expose the students to the concepts of feed forward neural networks
3. To provide adequate knowledge about feedback neural networks.
4. To provide adequate knowledge about fuzzy set theory.
5. To teach about the concept of fuzziness involved in various systems.
6. To expose the ideas about genetic algorithm

List of Experiments:

Student has to prepare computer programs and simulations for various soft computing techniques covered in this course with any computing tools (MatLab, Scilab)

Open Ended Problems:

Design and implementation of intelligent system for industrial process control , Industrial drives control , Power Converters & various applications.

Major Equipment: Computer Laboratory.

Open Source Software: Scilab

Learning website:

1. http://www.soft-computing.de/def.html
2. NPTEL