

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (09)

INTELLIGENT CONTROL

SUBJECT CODE: 2730703

M.E. 3RD SEMESTER

Type of course: NA

Prerequisite: Control System, Non-Linear Control System

Rationale: The control system is the decision making system (brain) of any physical systems. It is required to provide computational intelligence to the controllers so that the controllers becomes optimal, robust and self-learning. The artificial intelligence includes the Neural networks, Fuzzy Logic and Genetic Algorithms and having wide applications in the field of control system.

Teaching and Examination Scheme:

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

Content:

| Sr. No. | Content | Total Hrs | % Weightage |
|---------|--|-----------|-------------|
| 1 | UNIT I: INTRODUCTION Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems. | 09 | 10 |
| 2 | UNIT II : ARTIFICIAL NEURAL NETWORKS Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller | 09 | 20 |
| 3 | UNIT III : GENETIC ALGORITHM 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 ant-colony search techniques for solving optimization problems. | 09 | 20 |
| 4 | UNIT IV : FUZZY LOGIC SYSTEM Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time- | 09 | 20 |

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|----------|--|-----------|----|
| | delay system. | | |
| 5 | UNIT V : APPLICATIONS GA application to power system optimisation problem, Case studies: 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. | 09 | 30 |

Reference Books:

1. Padhy.N.P.(2005), Artificial Intelligence and Intelligent System, Oxford University Press.
2. KOSKO,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
3. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
4. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
5. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
6. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.
7. Goldberg D.E. (1989) Genetic algorithms in Search, Optimization and Machine learning, Addison Wesley.

Course Outcome:

After learning the course the students should be able to:

1. Understand and use the concepts of Artificial Intelligence i.e Fuzzy Logic, Neural Network and Genetic Algorithms to the system.
2. Design the Fuzzy Logic Controller, Neural Network based Controller
3. Optimization using Genetic Algorithm
4. Carryout the simulation for all the techniques using MATLAB

List of Experiments and Open Ended Problems:

The course coordinator can assign the simulation based assignment covering all the technique of Artificial Intelligence for controller design.

List of Open Source Software/learning website: MATLAB, SCILAB, NPETEL Videos

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.