



GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL (TRANSPORTATION ENGINEERING) (13)

Master of Engineering

Subject Code: 3731302

Semester – III

Subject Name: SOFT COMPUTING TECHNIQUES

Type of course: Program Elective V

Prerequisite: Nil

Rationale:

Soft computing is an emerging approach to computing which parallel the remarkable ability of the human mind to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on some biological inspired methodologies such as genetics, evolution, ant's behaviors, particles swarming, human nervous systems, etc. Now, soft computing is the only solution when we don't have any mathematical modeling of problem solving (i.e., algorithm), need a solution to a complex problem in real time, easy to adapt with changed scenario and can be implemented with parallel computing. It has enormous applications in many Engineering areas.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs
1	Introduction to Soft Computing <ul style="list-style-type: none">• Concept of computing systems.• "Soft" computing versus "Hard" computing• Characteristics of Soft computing• Some applications of Soft computing techniques	5
2	Fuzzy logic <ul style="list-style-type: none">• Introduction to Fuzzy logic.• Fuzzy sets and membership functions.• Operations on Fuzzy sets.• Fuzzy relations, rules, propositions, implications and inferences.• Defuzzification techniques.• Some applications of Fuzzy logic.	12
3	Genetic Algorithms	12



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	<ul style="list-style-type: none"> • Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques • Basic GA framework and different GA architectures. • GA operators: Encoding, Crossover, Selection, Mutation, etc. • Solving single-objective optimization problems using GAs. 	
4	Artificial Neural Networks <ul style="list-style-type: none"> • Biological neurons and its working. • Simulation of biological neurons to problem solving. • Different ANNs architectures. • Training techniques for ANNs. • Applications of ANNs to solve some real life problems. 	10
5	Hybrid Systems : <ul style="list-style-type: none"> • Fuzzy Neural systems • Genetic Fuzzy systems • Genetic Neural system 	6
TOTAL		45 Hr.

Suggested Specification table with Marks (Theory): (For ME only)

Bloom's Taxonomy for theory marks weightage (%) for cognitive Domain/level

Cognitive Domain	Remembrance	Comprehension	Application	Analysis	Evaluate	Create
Weightage (%)	10	10	20	20	20	20

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

The following text and reference books may be referred to for this course.

- Fuzzy Logic: A Practical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
- Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
- Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, Nikola K. Kasabov, MIT Press, 1998.
- Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elsevier Press, 2004.
- An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
- Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
- Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.



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- Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
- Soft Computing, D. K. Pratihari, Narosa, 2008.
- Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.
- Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.
- Timothy J.Ross, Fuzzy Logic with Engineering Applicatios, McGraw-Hill
- Simon Haykin, Neural Netwroks, PrenticeHall
- J.M. Zurada, .Introduction to artificial neural systems., Jaico Publishers
- H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.
- Suran Goonatilake, Sukhdev Khebbal (Eds), .Intelligent hybrid systems., John Wiley & Sons, New York, 1995
- Goldberg, D. E, Genetic algorithm in search, optimization and machine learning,Addison-Wesley, Reading Mass.
- Kalyanmoy Deb, Optimization for Engineering Design – Algorithms and examples, PHI, New Delhi, ISBN-81-203-0943-x.

List of Experiments:

(Work in Computation lab.)

1. Problems based on GA and its applications in transportation.
2. Problems based on Fuzzy logic and its applications in transportation.
3. Problems based on ANN and its applications in transportation.
4. Problems based on hybrid systems and its application in transportation.
5. Solving routing problem of mass transit system using GA
6. Developing trip generation relationship using ANN

7. Developing mode choice model using Fuzzy Logic
8. Obtaining optimal mix design of Bituminous Concrete using GA or Hybrid system

Course Outcomes: At the end of the course, Student will be able

Sr. No.	CO statement	Marks % weightage
CO-1	To understand fuzzy logic and its applications.	20%
CO-2	To understand artificial neural networks and its applications.	20%
CO-3	To solve single-objective optimization problems using GAs.	30%
CO-4	To get basic idea of modern computing techniques which are useful for solving the non-linear and complex functions that may come across during dissertation/research work.	20%
CO-5	To apply of Soft computing to solve problems in varieties of application domains.	10%



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List of Open Source Software/learning website:

Student can refer Open source Code and material available for example

- <http://www.iitk.ac.in/kangal/codes.shtml>
- <http://lancet.mit.edu/ga/dist/galibdoc.pdf>
- https://books.google.co.in/books?hl=en&lr=&id=W5SAhUqBVYoC&oi=fnd&pg=PR11&d=SOft+computing+course+&ots=et_2Nvjy_4&sig=jDXLrGIeD3zc4QUxvcEvC5FrFY#v=onepage&q=SOft%20computing%20course&f=false