

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**CIVIL (TRANSPORTATION ENGINEERING) (13)**  
**SOFT COMPUTING TECHNIQUES**  
**SUBJECT CODE: 2731302**  
**M.E. 3<sup>RD</sup> SEMESTER**

**Type of course:** Major Elective - IV

**Prerequisite:** Nil

**Rationale:** The field of engineering is a creative one. The problems encountered in this field are generally unstructured and imprecise influenced by intuitions and past experiences of a designer. The conventional methods of computing relying on analytical or empirical relations become time consuming and labor intensive when posed with real life problems. Travel demand modeling includes many problems having non-linear functions to solve, e.g. trip assignment, routing problem. Some of the problems require developing the relationship between independent variables with dependent variables, e.g. trip generation analysis. Some of the problems deal with perception of the users that ranges between some limits, e.g. mode choice modeling. These problems are complex in nature and difficult to solve mathematically. Therefore, soft computing techniques like Genetic Algorithms, Fuzzy logic and Artificial Neural Network can be applied effectively to solve these types of problems. This subject gives understanding of these techniques and their procedural aspects to solve the above mentioned problems.

**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# | 2 | 5       | 70                | 30      | 20              | 10     | 10 | 10 | 150         |

**Content:**

| Sr. No. | Content   | Total Hrs | % Weightage |
|---------|---|-----------|-------------|
| 1       | <b>Genetic Algorithms:</b><br>Goals of optimization, comparison with traditional methods, schemata, Terminology in GA – strings, structure, parameter string, data structures, operators, coding fitness function, algorithm, applications.   | 12        | 30          |
| 2       | <b>Fuzzy Logic:</b><br>Concepts of uncertainty and imprecision, sets, concepts, properties and operations on classical sets & fuzzy sets, classical & fuzzy relations, membership functions, fuzzy logic, fuzzification, fuzzy rule based systems, fuzzy propositions, and applications.  | 12        | 30          |
| 3       | <b>Artificial Neural Networks: Basics of ANN:</b><br>Models of a Neuron, Topology, Multi Layer Feed Forward Network (MLFFN), Radial Basis Function Network (RBFN), Recurring Neural Network (RNN), learning processes: supervised and unsupervised learning. error-correction learning, Hebbian learning; single layer perceptrons, multilayer perceptrons, least mean square algorithm, back propagation algorithm applications. | 12        | 30          |
| 4       | <b>Hybrid Systems:</b>  | 6         | 10          |

### Reference Books:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill
2. Simon Haykin, Neural Networks, Prentice Hall
3. J.M. Zurada, Introduction to artificial neural systems., Jaico Publishers
4. H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.
5. Suran Goonatilake, Sukhdev Khebbal (Eds), Intelligent hybrid systems., John Wiley & Sons, New York, 1995
6. Goldberg, D. E, Genetic algorithm in search, optimization and machine learning, Addison-Wesley, Reading Mass.
7. Kalyanmoy Deb, Optimization for Engineering Design – Algorithms and examples, PHI, New Delhi, ISBN-81-203-0943-x.

### Course Outcome:

After learning the course the students should be able:

1. 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.
2. To be conversant with artificial intelligent techniques like GA, Fuzzy logic, Artificial Neural Network and their hybrid systems which are used for solving different transportation problems.

### 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.

### Design based Problems (DP)/Open Ended Problem:

Below mentioned problems are for reference only. Similar problems may be developed by individual teachers.

1. Solving routing problem of mass transit system using GA
2. Developing trip generation relationship using ANN
3. Developing mode choice model using Fuzzy Logic
4. Obtaining optimal mix design of Bituminous Concrete using GA or Hybrid system

### List of Open Source Software/learning website:

Student can refer Open source Code and material available for example

1. <http://www.iitk.ac.in/kangal/codes.shtml>
2. <http://lancet.mit.edu/ga/dist/galibdoc.pdf>
3. [https://books.google.co.in/books?hl=en&lr=&id=W5SAhUqBVYoc&oi=fnd&pg=PR11&dq=SOft+computing+course+&ots=et\\_2Nvjy\\_4&sig=jDX-LrGIeD3zc4QUxvcEvC5FrFY#v=onepage&q=SOft%20computing%20course&f=false](https://books.google.co.in/books?hl=en&lr=&id=W5SAhUqBVYoc&oi=fnd&pg=PR11&dq=SOft+computing+course+&ots=et_2Nvjy_4&sig=jDX-LrGIeD3zc4QUxvcEvC5FrFY#v=onepage&q=SOft%20computing%20course&f=false)

**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.