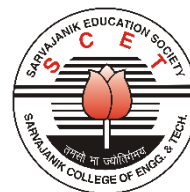




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**Sarvajani College of Engineering and Technology**  
**Bachelor of Technology**



**B. Tech. Semester V**

**Subject Name:** Introduction to Soft Computing

**Subject Code:** BTEC14503

**Type of course:** PEC

**Prerequisite:** Probability and Statistics

**Rationale:** Soft computing is an emerging approach that exploits the amazing ability of the human mind, providing precise solutions for real-life problems. The concept of soft computing is based on learning from experimental data. It means that soft computing does not require any mathematical model to solve the problem. It helps users to solve real-world problems by providing approximate results that conventional and analytical models cannot solve.

**Teaching and Examination Scheme:**

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

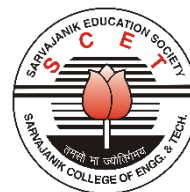
**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module % Weightage
1.	<b>Introduction to Soft Computing:</b> Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques.	5	10
2.	<b>Fuzzy Systems:</b> Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications. Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, and Fuzzy Classification. Defuzzification techniques. Fuzzy logic controller design. Some applications of Fuzzy logic.	8	25
3.	<b>Artificial Neural Networks:</b> ANN- Basics, learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Back propagation (BP) Networks, Recent Applications	12	25
4.	<b>Modern techniques of soft computing:</b> <b>Genetic Algorithms:</b> Introduction, Representation of Design Variables, Representation of Objective Function and Constraints, Genetic Operators, Algorithm. <b>Simulated Annealing:</b> Introduction, Procedure, Algorithm, Features of the Method.	14	25



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	<p><b>Particle Swarm Optimization:</b> Introduction, Computational Implementation of PSO, Improvement to the Particle Swarm Optimization Method, Solution of the Constrained Optimization Problem.</p> <p><b>Ant Colony Optimization:</b> Basic Concept, Ant Searching Behaviour, Path Retracing and Pheromone Updating, Pheromone Trail Evaporation, Algorithm.</p>		
5.	<p><b>Introduction to Hybrid Systems and Multi-objective Optimization</b>            Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.            Concept of multi-objective optimization problems (MOOPs) and issues of solving them</p>	6	15

**Suggested Specification table with Marks (Theory/Practical):**

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	30	10	5	5

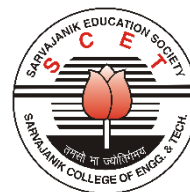
**Legends: R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom’s Taxonomy**) **Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Text Books:**

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications	S. Rajasekaran, G. A. Vijayalakshami	PHI	2013	Latest
2.	Soft Computing and Intelligent Systems - Theory and Application	Naresh K. Sinha and Madan M. Gupta	Academic Press	2000	Latest
3.	Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence	J. S. R. Jang, C. T. Sun, and E. Mizutani	Prentice Hall	2015	Latest



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4.	Engineering Optimization - Theory and Practice	Singeresu S Rao	Wiley	2019	5 <sup>th</sup>
5.	Neural Networks: A Comprehensive Foundation	Simon S. Haykin	Prentice Hall	1999	Latest

**Course Outcome:**

Sr. No.	CO Statement After learning this subject students will be able to,	Marks % weightage
CO-1	Describe the paradigm of soft computing techniques.	20
CO-2	Implement Fuzzy system for finding the optimal solutions for real life problems	20
CO-3	Implement neural networks for finding the optimal solutions for real life problems	25
CO-4	Implement Genetic algorithm, Simulated Annealing , Particle Swam Optimisation and Ant Colony optimisation methods for finding the optimal solutions for real life problems	20
CO-5	Design hybrid systems to solve various applications using the principles of soft computing	15

**Mapping with POs:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	1	1	1	1	2	1	-	2	2	2	2	-	1
CO-2	2	3	2	2	3	2	1	1	2	2	2	2	3	3	3
CO-3	2	3	2	2	3	2	1	1	2	2	2	2	3	3	3
CO-4	2	3	2	2	3	2	1	1	2	2	2	2	3	3	3
CO-5	2	3	2	2	3	2	1	1	2	2	2	2	3	3	3

**List of practical:**

1. Introduction to Python libraries for Fuzzy Logic and Neural Network.
2. Develop Fuzzy inference system to implement given logic gate(s).
3. Develop Fuzzy inference system for given application.
4. Implement a Neural Network from scratch using Python Programming.
5. Implement the EX-OR Gates using Python coding.
6. Implement Genetic Algorithm for the given application. Find out the average of Fitness



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- function after each Iteration and Select the Optimal Value.
7. Implement Particle Swarm Optimization for the given application. Find out the average of Fitness function after each Iteration and Select the Optimal Value.
  8. Implement Simulated Annealing for the given application. Find out the average of Fitness function after each Iteration and Select the Optimal Value.
  9. Mini -project in a group of two.

**List of Open Source/learning websites:**

- <https://nptel.ac.in/courses/106105173>- Introduction to Soft Computing
- <https://nptel.ac.in/courses/106105173>- Introduction to Fuzzy Logic
- <https://nptel.ac.in/courses/106105173>- Introduction to Artificial Neural Network
- <https://nptel.ac.in/courses/105108127>- Evolutionary algorithms for Optimization

**List of Open Source software:**

- Scilab,
- Python/Anaconda
- Visual Studio