FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **VI**

Course Code: **202060622**

Course Title: **Soft Computing Techniques**

Course Group: **Open Elective**

Course Objectives: This course introduces an insight for Soft Computing concepts and algorithms to develop an intelligent system. Further, to give students knowledge about non-traditional techniques and fundamentals of artificial neural networks, fuzzy logic and genetic algorithms. To provide students hands-on experience on recent soft computing tool (i.e., MATLAB, Python, etc.) to implement various strategies and real-life problems. To gain experience of doing independent study and research.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
2	0	2	3	50/18	50/17	25/9	25/9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction to soft computing:** Introduction, Importance of Soft Computing, Main Components of Soft Computing – Fuzzy Logic, Artificial Neural Networks, Support Vector machine, Evolutionary Algorithms, Hybrid Intelligent Systems and applications of soft computing.	4
2	**Fuzzy Logic Systems:** Introduction to Fuzzy logic, classical sets *vs* fuzzy sets, Membership functions and its features, Properties and operations on Fuzzy sets, classical relations *vs* Fuzzy relation, Operations of Fuzzy relation, Defuzzification, Fuzzy rule base and approximate reasoning, Fuzzy Inference Systems, Design a fuzzy logic controller: Mamdani & Sugeno Architecture.	10

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
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3	**Neural Network Systems:** Introduction to Artificial Neural Network, Biological neurons *vs* artificial neural network, Neuron models: McCulloch-Pitts Neuron, Hebb Network, learning in neural networks: **Supervised Learning Network** – Perceptron, ADALINE, MADALINE, Back propagation network, **Unsupervised Learning Network** – Self organizing Map, Learning Vector Quantization, Adaptive resonance theory.	**10**
4	**Genetic Algorithms:** 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**
5	**Hybrid Systems and Applications:** Hybrid Soft computing Techniques – Fuzzy-Neural, Neuro-Fuzzy, Genetic-Fuzzy, Genetic-Neuro, Applications in various domain.	**2**
		30

List of Practicals / Tutorials:

1	Introduction to MATLAB / Python Tool for Soft Computing Applications.
2	Introduction: Fuzzy Logic Toolbox, Fuzzy Logic Simulink Demos.
3	MATLAB simulation: Fuzzy Logic Controller (FLC) implementation.
4	MATLAB simulation: Simulink Fuzzy Logic Controller (FLC) implementation.
5	MATLAB simulation: Implement any one application using FLC.
6	Introduction: Neural Network (NN) Toolbox, NN Simulink Demos
7	MATLAB simulation: Artificial Neural Network (ANN) implementation.
8	MATLAB simulation: NN Tool Artificial Neural Network (ANN) implementation.
9	MATLAB simulation: Various structure of NN algorithms implementation
10	Introduction: Genetic Algorithm (GA), Simulation Demos.
11	Simulation Assignment: Application Development using Fuzzy / NN /GA.

Reference Books:

1	S. N. Sivanandam and S.N.Deepa, Principles of Soft Computing, Wiley India Pvt. Limited.
2	R. Rajasekaran, and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India.
3	T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill
4	L. Fausett, Fundamentals of Neural Networks, Prentice Hall
5	Suran Goonatilake, and Sukhdev Khebbal (Eds), Intelligent hybrid systems, John Wiley & Sons.
6	D. E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison-Wesley.

Supplementary learning Material:	
1	MATLAB: Signal Processing Toolbox, Image Processing Toolbox, Neural Network Toolbox, Fuzzy Logic Toolbox, Optimization Toolbox.

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2	Python Programming and Application Development
3	NPTEL / Coursera courses on Soft Computing, Neural Network, Fuzzy Logic and Genetic Algorithm.
4	Python based Application Development

Pedagogy:
Direct classroom teaching
Audio Visual presentations/demonstrations
Assignments/Quiz
Continuous assessment
Interactive methods
Seminar/Poster Presentation
Industrial/ Field visits
Course Projects

Internal Evaluation:
The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
10	20	20	20	20	10	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Identify and describe soft computing techniques and their roles in building intelligent systems.	**15**
CO-2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.	**25**
CO-3	Integrate and develop learning mechanism using Neural Network for intelligent applications.	**25**
CO-4	Solved Optimization problem using genetic algorithms.	**10**
CO-5	Judge the role played by engineers to automate the process by integrating the knowledge of soft-computing tools and techniques.	**25**

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Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June -2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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