Soft Computing

1.1 Course Number: CS468

1.2 Contact Hours: 2-0-2 Credits: 8

1.3 Semester-offered: 4th Year-Even

1.4 Prerequisite: Probability and Statistics, Vectors, C++/Java/ Matlab programming

1.5 Syllabus Committee Member: Dr. Sushum Biswas, Dr. Daya Sagar Gupta & Dr. Gargi Srivastava

2. **Objective:** In this course we will study the techniques of soft computing, especially evolutionary computation, fuzzy logic, GA and neural networks. We will begin with introductory discussions of how the techniques function in solving problems in the real world. Then we will move on to the hybrid of multiple techniques and how to choose the appropriate techniques for the problems that you want to solve.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Soft Computing	Introduction, requirement, different tools and techniques, usefulness and applications.	3
2	Fuzzy sets and Fuzzy logic	Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.	10
3	Artificial Neural Network	Introduction, basic models, Hebb's learning, Adaline, Perceptron, Multilayer feed forward network, Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.	10
4	Evolutionary and Stochastic techniques	Genetic Algorithm (GA), different operators of GA, analysis of selection operations, Hypothesis of building blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications.	8
5	Rough Set & Hybrid Systems	Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications. Neural-Network-Based Fuzzy Systems,	9

		Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.	
		Total	**40**

4. Readings

4.1 Textbook:

Fuzzy sets and Fuzzy logic by George Klir , Bo Yuan, PHI

Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis Rajsekharan, Vijayalaxmi Pai

Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997

4.2 Reference books:

Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.

5 Outcome of the Course:

1. Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
2. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
3. Describe genetic algorithms and other random search procedures useful while seeking global optimum in self learning situations.
4. Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications.
5. Develop some familiarity with current research problems and research methods in Soft Computing Techniques