SOFT COMPUTING (Major Elective – I)
Semester I (Computer Engineering)
SUB CODE: MECE106-B

Teaching Scheme (Credits and Hours)

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
04	00	02	06	05	3	70	30	20	30	150

LEARNING OBJECTIVES:

The objective of this course is to learn:

- The general concepts and techniques in soft computing.
- How to apply some of the techniques to practical problems.

OUTLINE OF THE COURSE:

Unit No	Topics
1	Aims of Soft Computing
2	Foundations of Fuzzy Sets Theory
3	Fuzzy Logic
4	Artificial Neural Networks
5	Probabilistic Reasoning
6	Genetic Algorithms
7	Neuro-Fuzzy Technology
8	Combination of Genetic Algorithms with Neural Networks
9	Combination of Genetic Algorithms and Fuzzy Logic
10	Neuro-Fuzzy-Genetic Approach
11	Other Combinations of the Constituents of Soft Computing
12	Soft Computing Applications

Total hours (Theory): 60

Total hours (Practical): 30

Total hours: 90

DETAILED SYLLABUS:

Sr. No	Topic	Lecture Hours	Weight age (%)
1	**Aims of Soft Computing** Soft Computing (SC) as Key Methodology for Designing of Intelligent Systems Structure and Constituents of Soft Computing Comparative Characteristics of the Constituents of SC Intelligent Combinations of the Components of SC	06	05
2	**Foundations of Fuzzy Sets Theory** Basic Concepts and Properties of Fuzzy Sets Basic types of fuzzy sets Properties of fuzzy sets Representations and constructing of fuzzy sets Extension principle for fuzzy sets Operations on fuzzy sets Probability and fuzziness Fuzzy Sets and possibility theory Elements of Fuzzy Mathematics Fuzzy topology and fuzzy algebra Fuzzy geometry Fuzzy arithmetic Fuzzy analysis Fuzzy differential equiations Fuzzy Relations Fuzzy relations. Linguistic variables Fuzzy relational equations	06	15
3	**Fuzzy Logic** Brief Overview of Classical Logic Elements of Fuzzy Logic Semantic Analysis of Different Fuzzy Logic Fuzzy Inference Rules and Approximate Reasoning Formalization of the Fuzzy Conditional Inference for a Different Type of Conditional Propositions Experimental Selecting Appropriate Fuzzy Implications Application Fuzzy Modelling Fuzzy Decision Making Pattern Analysis and Classification Fuzzy Control Systems Fuzzy Information Processing Fuzzy information systems Fuzzy data base and fuzzy operations in fuzzy database management systems Fuzzy information retrieval Fuzzy Robotics Fuzzy control system for robot	08	15

	Optimal path planning for a mobile intelligence robot with fuzzy resolution principle		
4	**Artificial Neural Networks** Models of Neuron. Basic Architectures of Neural Networks Feed-Forward Neural Networks Recurrent Neural Networks Time-Delay Neural Networks Radial Basis Function Neural Networks Cerebellar Model Articulation Controller Adaptive Resonance Theory (ART) NN Associative Neural Memory Models Supervised Learning of Neural Networks Perceptron learning algorithm Widrow-Hoff learning rule Delta rule Error backpropagation algorithm Recurrent backpropagation Unsupervised Learning Hebbian learning Competitive learning Kohonen's learning Reinforcement Learning Applications Neural identification and control Adaptive predictive neural control system for industrial robot BioMedical Pattern Recognition	08	15
5	**Probabilistic Reasoning** Bayesian Approach Dempster-Shafer Theory of Belief Upper and Lower Prevision Mixed Formalism Based Reasoning References	08	15
6	**Genetic Algorithms** Genetic Algorithms. Main Operators Genetic Algorithm Based Optimization Genetic Algorithm with Group Principle Group Genetic Algorithms with Directed Mutation Comparison of Conventional and Genetic Search Algorithms Applications Genetic algorithms based identification and control	06	10
7	**Neuro-Fuzzy Technology** Fuzzy Neural Networks and Their Learning Fuzzyneural networks General learning algorithm for fuzzy neural network Learning of F NN by applying a-cuts	08	10

	Architecture of Neuro-Fuzzy Systems Generation of Fuzzy Rules and Membership Functions Fuzzification and Defuzzification in Neuro-Fuzzy Systems Neuro-Fuzzy Identification Neuro-Fuzzy Control Neuro-Fuzzy Navigation System for Intelligent Robot Handwritten Image Recognition by Using Neuro-Fuzzy Approach		
8	**Combination of Genetic Algorithms with Neural Networks** Neural Networks and Genetic Algorithms Use of Genetic Algorithms for Neural Network Learning	06	05
9	**Combination of Genetic Algorithms and Fuzzy Logic** GA-Based Method for Defining of Relational Matrix and Membership Functions Design of Fuzzy Knowledge Base by Using Genetic Algorithms Fuzzy Genetic Algorithms Use of fuzzy approach in genetic algorithms fortuning the search directions Fuzzy logic based genetic algorithms Fuzzy-Genetic Modeling Genetic Algorithms Based Fuzzy Regression Analysis Color Recognition with Using Fuzzy Logic and Genetic Algorithm	02	05
10	**Neuro-Fuzzy-Genetic Approach** Genetic Algorithms in Learning of Fuzzy Neural Networks Genetic Algorithm Based Fuzzy Neural Networks Control System	02	05
11	**Other Combinations of the Constituents of Soft Computing** Fuzzy Expert Systems Using Bayes-Shortliffe Approach Fuzzy Chaos Based Tuning of Fuzzy Controller Soft Computing Based Multi-Module Forecasting Time Series System		
12	**Soft Computing Applications** Soft Computing based Distributed Intelligent Systems Soft Computing in Computer vision and Image Processing Soft Computing in Network Security Soft Computing in Information Retrieval Soft Computing in Agriculture		

INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.

- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

STUDENTS LEARNING OUTCOMES:

On successful completion of the course, the student should be able to:

- Identify and describe soft computing techniques and their roles in building intelligent machines
- Identify and describe soft computing techniques and their roles in building intelligent machines
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
- Apply neural networks to pattern classification and regression problems
- Apply genetic algorithms to combinatorial optimization problems
- Effectively use existing software tools to solve real problems using a soft computing approach
- Evaluate and compare solutions by various soft computing approaches for a given problem

REFERENCE BOOKS:

1. Soft Computing and its applications, R.A.Aliev, World Scientific Publishing Co. Pte. Ltd.
2. Principles of Soft Computing, S.N.Sivanandam, S.N.Deepa, Wiley India.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, S. Rajasekaran, G. A. Vijayalakshmi Pai, PHI
4. Fuzzy logic with Engineering Applications, Timothy J Ross, McGrawHill ,New York.
5. Neural Networks a Comprehensive foundation, S.Haykins, Pearson Education.
6. D.E.Goldberg, Genetic Algorithms in Search Optimisation and Machine Learning, Pearson Education.
7. Neural Networks, Fuzzy Logic and Genetic Algorithms:Synthesis & Applications, S. Rajasekaran, G. A. Vijayalakshami, PHI.
8. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI
9. Compensatory Genetic Fuzzy Neural Networks and Their Applications, Yanqing Zhang and Abraham Kandel, World Scientific.
10. Recent Literature.

LIST OF PRACTICALS:

Sr. No.	Title
FUZZY LOGIC	
1	WRITE A MATLAB PROGRAM TO IMPLEMENT FUZZY SET OPERATION AND PROPERTIES.
2	WRITE A PROGRAM TO IMPLEMENT COMPOSITION OF FUZZY AND CRISP RELATIONS.
3	WAP TO PERFORM MAX-MIN COMPOSITION OF TWO MATRICES OBTAINED FROM CARTESIAN PRODUCT.
4	WAP TO VERIFY THE VARIOUS LAWS ASSOCIATED WITH FUZZY SET.
ARTIFICIAL NEURAL NETWORK	
5	WAP TO IMPLEMENT AND FUNCTION USING ADALINE WITH BIPOLAR INPUTS AND OUTPUTS.
6	WAP TO IMPLEMENT AND FUNCTION USING MADALINE WITH BIPOLAR INPUTS AND OUTPUTS.
7	WRITE A MATLAB PROGRAM TO IMPLEMENT DISCRETE HOPFIELD NETWORK AND TEST FOR INPUT PATTERN.
8	WRITE A MATLAB PROGRAM TO IMPLEMENT FULL COUNTER PROPAGATION NETWORK FOR A GIVEN INPUT PATTERN.
9	WRITE A MATLAB PROGRAM TO IMPLEMENT BACK PROPAGATION NETWORK FOR A GIVEN INPUT PATTERN.
10	WAP TO IMPLEMENT ART 1 NETWORK FOR CLUSTERING INPUT VECTORS WITH VIGILANCE PARAMETER.
GENETIC ALGORITHM	
11	WRITE A MATLAB PROGRAM FOR MAXIMIZING F(X)=X2 USING GA, WHERE X IS RANGES FROM 0 TO 31. PERFORM ONLY 5 ITERATIONS.