INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**SOFT COMPUTING**			
Course Code	BCS208			
Regulation	**R15-JNTUH**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	3	-	-	3
Course Coordinator	Ms G Geetha			
Team of Instructors	Ms G Geetha			

I. COURSE OVERVIEW:

Soft Computing, or better known by the individual constituents of Neural Networks, Evolutionary Algorithms and Fuzzy Logic, is arguably every student/research project's success and cheat sheet. And the increasing pressures on producing novel systems, often confused with more complicated systems, brings in plenty of ways of combine these techniques in any manner - naturally or forcefully. Immense problem solving capabilities, technology behind every tough looking application title, lots of possibilities to create minor/major variants to quote novelty and lots of areas to research. Find out more about the technology and use it for your problem of choice.

II. PREREQUISITES:

Level	Credits	Periods/Weeks	Prerequisites
PG	3	45	Artificial Intelligence, Fuzzy Systems.

III. COURSE ASSESSMENT METHODS:

a) Marks Distribution

Session Marks(25M)	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain 4 questions; the student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20 minutes. It consists of 10 multiple choice and 10 objective type questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	-	05
3	II Mid Examination	90 minutes	20
4	II Assignment	-	05
5	External Examination	3 hours	75

V. COURSE OBJECTIVES:

i. Familiarize with soft computing concepts.
ii. Understand supervised learning and unsupervised learning networks.
iii. Introduce the ideas of neural networks, fuzzy logic.

VI. COURSE OUTCOMES:

i. Understand the need for Soft Computing.
ii. Be able to develop rules to reason in a fuzzy environment.
iii. Build automatic systems that learn through interaction with the environment.
iv. Understand the difference between a fuzzy and a deterministic or probabilistic system.
v. Understand the steps involved in the development of Soft Computing.
vi. Acquire a working knowledge of some popular tools for Soft Computing.
vii. Be able to develop mathematical models (regression models) for system identification.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems **(Engineering Knowledge)**	H	Assignment, Tutorials
PO2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).**	H	Assignments
PO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).**	S	Project
PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).**	S	Project
PO5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations **(Modern Tool Usage).**	S	Project
PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).**	N	--
PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).**	N	--
PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).**	N	--
PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).**	N	--
PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).**	N	--
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	--
PO12	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change **(Life-long learning)**.	S	Project

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.	H	Lectures, Assignments
PSO2	**Problem-solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	H	Projects
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.	S	Guest Lectures

N - None S - Supportive H - Highly Related

IX. SYLLABUS:

UNIT-I
INTRODUCTION TO NEURAL NETWORKS

Introduction: Fundamental concept, evolution of neural networks, models of artificial neural networks, important technologies, applications, McCulloch, Pitts Neuron, linear separability, Hebb network; Supervised learning network: Perception networks, adaptive linear neuron, multiple adaptive linear neurons, back propagation network, radial basis function network.

UNIT-II
ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

Associative memory networks: Training algorithms for pattern association, auto associative memory network, hetero associative memory network, bidirectional associative memory, Hopfield networks, iterative auto associative memory network, temporal associative memory network; Unsupervised learning networks: Kohonen self organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network.

UNIT-III
FUZZY LOGIC

Fuzzy logic: Introduction to classical/crisp sets and fuzzy sets, classical/crisp relations and fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.

Membership functions: Fuzzification, methods of membership value assignments, defuzzification, Lambda cuts for fuzzy sets and fuzzy relations, defuzzification methods.

UNIT-IV
FUZZY ARITHMETIC

Fuzzy arithmetic and fuzzy measures: Fuzzy rule base and approximate reasoning, truth values and tables in fuzzy logic, fuzzy propositions, formation of rules, decomposition and aggregation of rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making, fuzzy logic control systems, fuzzy expert systems.

UNIT-V
GENETIC ALGORITHMS

Genetic algorithm and search space, general genetic algorithm, operators, generational cycle, stopping condition, constraints, classification, genetic programming, multilevel optimization; Applications: A fusion approach of multispectral images with SAR image for flood area analysis, optimization of travelling salesman problem using genetic algorithm approach, and genetic algorithm based internet search technique, soft computing based hybrid fuzzy controllers.

Text Books:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro, "Fuzzy and Soft Computing", PHI, Pearson Education, 1st Edition, 2004.
2. S. N. Sivanandan, S. N. Deepa, "Principles of Soft Computing", Wiley India, 2nd Edition, 2007.

Reference Books:

1. S. Rajasekaran, G. A. V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 1st Edition, 2003.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Mc Graw Hill, 3rd Edition, 1997.
3. Stamatios V. Kartalopoulos "Understanding Neural Networks and Fuzzy Logic Basic Concepts and Applications", IEEE Press, PHI, New Delhi, 2004.

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following Course Learning Outcomes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-3	**Understand** literature of neural networks	Introduction: Fundamental concept, evolution of neural networks, models of artificial neural networks, important technologies, applications, McCulloch, Pitts Neuron.	T2:1.1-1.2
4-6	**Understand and develop** learning techniques	linear separability, Hebb network; Supervised learning network: Perception networks, adaptive linear neuron.	T1:2
7-9	**Retrieve** linear equations and **Understand** back propagation	multiple adaptive linear neurons, back propagation network, radial basis function network.	T2:2.1-2.2
10-12	**Understand** associative memory types	Associative memory networks: Training algorithms for pattern association, auto associative memory network, hetero associative memory network.	T1:4
13-16	**Understand** the concept of regression analysis to find the hidden relations in data.	bidirectional associative memory, Hopfield networks, iterative auto associative memory network, temporal associative memory network;	T1:4
17-19	**Understand** the concepts of unsupervised learning	Unsupervised learning networks: Kohonen self organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network.	T1: 6
20-22	**Understand** the concepts of fuzzy sets and relations	Fuzzy logic: Introduction to classical/crisp sets and fuzzy sets, classical/crisp relations and fuzzy Relations	T1: 5
23-25	**Identify** iterative and non-iterative fuzzy sets	Tolerance and equivalence relations, non-iterative fuzzy sets. Membership functions: Fuzzification	T1:7
26-28	**Understand** methods of defuzzification	Methods of membership value assignments, defuzzification, Lambda cuts for fuzzy sets and fuzzy relations, defuzzification methods.	T1:10
29-31	**Develop** truth tables of fuzzy logic	Fuzzy arithmetic and fuzzy measures: Fuzzy rule base and approximate reasoning, truth values and tables in fuzzy logic,	T1:8
32-34	**Understand** formation rules and aggregation rules	fuzzy propositions, formation of rules, decomposition and aggregation of rules, fuzzy reasoning	T1:8 T1:13
35-37	**Develop** fuzzy interface system and fuzzy expert system	fuzzy inference systems, fuzzy decision making, fuzzy logic control systems, fuzzy expert systems.	T1:9 T1:14 T1: 17

38-40	**Understand** genetic algorithms, constraints and classifications	Genetic algorithm and search space, general genetic algorithm, operators, generational cycle, stopping condition, constraints, classification	T1: 17
41-45	**Understand** the fusion approach	genetic programming, multilevel optimization; Applications: A fusion approach of multispectral images with SAR image for flood area analysis, optimization of travelling salesman problem using genetic algorithm approach, and genetic algorithm based internet search technique, soft computing based hybrid fuzzy controllers.	T1:16

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I			H		H							S	H	S	
II	H	S								H			H	S	
III		H	S	S									S		
IV	H	S											H	S	
V					S					H			H		S

S= Supportive H = Highly Related

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	S	S			H	H						H	S	
2	H			S									S		
3			H		S								H	S	
4	S	H											S	H	
5	H	S											S	H	
6	H			S								S	H	S	

S= Supportive H = Highly Related

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Mr. C. Raghavendra, Assistant Professor

HOD CSE