INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**INTELLIGENT CONTROLLERS**			
Course Code	**BPE 214**			
Regulation	**2017-18**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	3	-	-	3
Course Coordinator	**Dr. S. Vathsal professor**			
Team of Instructors	**Dr. S. Vathsal professor**			

I. COURSE OVERVIEW:

i) Understand biological and artificial neurons

ii) Explain models and control schemes

iii) Demonstrate Fuzzy Logic and control Schemes

iv) Understand Genetic Algorithms

v) Understand PC based instrumentation

II. PREREQUISITES:

Level	Credits	Periods	Prerequisite
PG	3	3	Knowledge of basics of control systems is required.

III. COURSE ASSESSMENT METHODS:

Marks distribution:

Session Marks	University end Exam Marks	Total Marks
There shall be two continuous internal assessments (CIA). Each continuous internal assessment is for 30 marks, with subjective exam for 25 marks (duration of 2 hours) and 5 marks for technical paper and term paper. Subjective test of each CIA in the semester shall contain Part-A with 5 compulsory question to answer of one mark each and Part-B with 5 questions each carrying 5 marks and to be answer any four questions. The average of two CIA is the final internal marks.	30 70	100 100

The external question paper approved by COE contains 5 internal choice questions each carrying 14 marks giving an total of 70 marks and to be answer all 5 questions		

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I CIA examination	2 Hours	25
2	I technical paper and term paper	--	05
3	II CIA examination	2 Hours	25
4	II technical paper and term paper	--	05
5	External examination	3 hours	70

V. COURSE OBJECTIVES:

At the end of the course, the students will be able to:

i) Design Feedforward and feedback Neural Networks
ii) Understand Learning schemes of neural networks
iii) Work on Back propagation algorithm
iv) Learn Fuzzy logic and crisp logic
v) Design Fuzzy controllers with if then rules
vi) Explain Genetic algorithms
vii) Implement Neural networks and Fuzzy logic controllers in Matlab /pc

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

i)Use neural networks to design Intelligent controllers
ii)Apply rules of Fuzzy sets to define fuzziness in systems and control errors
iii) Drawing of Fuzzy logic controller Table Using IF then rules
iv)minimize control errors using genetic algorithms
v)Matlab simulation of Intelligent controllers

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Level	Proficiency assessed by
PO1	**General Knowledge**: An ability to apply the knowledge of mathematics, science and Engineering for solving multifaceted issues of Electrical Engineering.	S	Discussion
PO2	**Problem Analysis**: An ability to communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems.	S	Assignments
PO3	**Design / Development of Solutions**: To develop Broad theoretical knowledge in Electrical Engineering and learn the methods of applying them to identify, formulate and solve practical problems involving electrical power.	N	--

PO4	**Conduct Investigations of Complex Problems**: An ability to apply the techniques of using appropriate technologies to investigate, analyze, design, simulate and/or fabricate/commission complete systems involving generation, transmission and distribution of electrical energy	H	Discussion
PO5	**Modern tool usage:** An ability to model real life problems using different hardware and software platforms, both offline and real-time with the help of various tools along with upgraded versions.	H	Discussion ,Assignment
PO6	**The Engineer and Society:** An Ability to design and fabricate modules, control systems and relevant processes to meet desired performance needs, within realistic constraints for social needs.	N	--
PO7	**Environment and Sustainability:** An ability To estimate the feasibility, applicability, optimality and future scope of power networks and apparatus for design of eco-friendly with sustainability	N	--
PO8	**Ethics:** To Possess an appreciation of professional, societal, environmental and ethical issues and proper use of renewable resources.	N	--
PO9	**Individual and Team Work:** an Ability to design schemes involving signal sensing and processing leading to decision making for real time electrical engineering systems and processes at individual and team levels	S	Discussion ,Assignment
PO10	**Communication:** an Ability to work in a team and comprehend his/her scope of work, deliverables , issues and be able to communicate both in verbal ,written for effective technical presentation.	N	--
PO11	**Life-long Learning:** An ability to align with and upgrade to higher learning and research activities along with engaging in life-long learning.	H	Discussion ,Seminar
PO12	**Project Management and Finance**: To be familiar with project management problems and basic financial principles for a multi-disciplinary work.	H	Discussion ,Seminar

N= None S=Supportive H=Highly related

Program Specific Outcomes		**Level**	**Proficiency assessed by**
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	N	--
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	S	Projects

PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	S	Projects

N – None **S - Supportive** **H- Highly Related**

VIII. :SYLLABUS

UNIT-I **NEURAL NETWORKS** **Classes: 09**

Neural networks, biological neurons, artificial neurons, activation function, learning rules, feed forward networks, supervised and unsupervised learning, perceptron network, linear separability, back propagation networks algorithms, radial basis function networks.

UNIT-II **MODELS AND CONTROL SCHEMES IN ANN** **Classes:10**

Auto and hetero associative memory, bidirectional associative memory, self organizing feature maps, Hopfield networks, neural networks for non linear system, schemes of neuro control, system identification, forward model and inverse model , case studies.

UNIT-III **FUZZY LOGIC AND ITS CONTROLLERS** **Classes:08**

Fuzzy set, Crisp set, vagueness, uncertainty and imprecision, fuzzy set, fuzzy operation, properties, crisp versus fuzzy relations, fuzzy relations, fuzzy cartesian product and composition, composition of fuzzy relations, fuzzy to crisp conversion.

Structure of fuzzy logic controller, database, rule base inference engine.

UNIT-IV **GENETIC ALGORITHMS** **Classes:09**

Genetic Algorithms: Working principles, terminology, importance of mutation, comparison with traditional methods, constraints and penalty function, GA operators, real coded GA.

UNIT-V **APPLICATIONS** **Classes:09**

Applications of neural network, fuzzy system and genetic algorithms for power systems and power electronics systems, designing of controllers using simulation software, NN tool box and fuzzy Logic toolbox.

Text Books:

T1. Zimmerman H.J. “Fuzzy set theory and its applications”, Kluwer Academic Publishers, 1st Edition, 1994.
T2. Simon Haykin, “Neural Networks A comprehensive foundation”, Pearson Education Asia, 1st Edition, 2002.
T3. Kalyanmoy Deb, “Optimization for engineering design”, Prentice Hall India, 1st Edition, 1988.
T4. David E.Goldberg, “Genetic Algorithms in search,optimization and machine learning”, Pearson Education , 1st Edition, 1989.

Reference Books:

R1. Lawrence Fausatt, “Fundamentals of neural networks”, Prentice Hall India, New Delhi, 1994.
R2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill International Edition, USA,. 1997.
R3. Bart kosko, “Neural Networks and Fuzzy Systems”, Prentice Hall of India, New Delhi, 1994.
R4 Jack M.Zurada, “Introduction to Artificial Neural Systems”, Jaico publishing house 2006.

Web References:

W1. https:// www.en.wikipedia.org/wiki/ neural networks
W2. https://www.jaicobooks.com/j/PDF%20HED/J-878%20Artificial%20Neural%20Systems.pdf.
W3. https://www.abebooks.co.uk/book-search/title/an-introduction-to-fuzzy-control/system.pdf

E-Text Books:

E1. https://www.engr.mun.ca/~baxter/Publications/ClassicalvsIntelligentControl.pdf
E2. https://www.werbos.com/HICChapter3.pdf
E3. https://www.engr.mun.ca/~baxter/Publications/ClassicalvsIntelligentControl.pdf

.

IX. COURSE PLAN:

The course plan is meant as a guideline. There may be probably be changes.

Lecture No.	Topics to be Covered	Course Learning Objectives	Reference
1	Biological neurons and neural networks	Learn natural and artificial neurons	T2,R1
2	Activation function	Learn nonlinear sigmoid function	T2,R1
3	Learning rules	Changing weightage matrix	T2,R4
4	Feedforward networks	Multistage neural networks	T2,R1
5	unsupervisory and supervisory learning rules	Like open loop and closed loop	T2,R3
6	Perceptron network	Single stage neural network	T2,R3
7	Linear separability	Linear and nonlinear separation	T2,R3
8	Back propagation network algorithm	Back propagation learning	T2,R4
9	Radial basis function networks	Transformation to convert nonliaer to linear network	T2,R4
10	Auto and hetero associative memory	Similar to computer memory	T2,R1
11	Bidirectional Associative memory	Similar to computer memory	T2,R1
12	Self organizing feature maps	Special function of NN	T2,R3
13	Hopf field networks	Special network	T2,R3
14	Neural network for nonlinear systems	RBF network	T2,R3
15	Schemes of Neuro control	Use of NN for control	T2,R4
16	System Identification	Training NN with input output data	T2,R4
17	Case studies	Example1	T2,R4
18	Case studies	Example2	T2,R4
19	Fuzzy & Crisp sets Vagueness	Membership function	T1,R2

20	Uncertainty and imprecision	fuzziness	T1,R2
21	Fuzzy set and fuzzy operation	Membership functions	T1,R2
22	properties	Linguistic variables	T1,R2
23	Crisp vs fuzzy relations	If then rules of Fuzzy logic	T1,R2
24	Fuzzy Cartesian products and composition	Rules of fuzzy logic	T1,R2
25	Fuzzy to crisp conversion	defuzzification	T1,R2
26	Structure of FLC	Data base rule base inference Engine	T1,R2
27	Genetic Algorithms	New optimization technique	T4
28	Working principles	algorithm	T4
29	Terminology	chromosomes	T4
30	mutation	Importance in genetics	T4
31	comparison with traditional methods	Formula vs iteration	T4
32	Constraints & penalty functions	Same for both methods	T4
33	GA operations	Flow chart	T4
34	Real coded GA1 & GA2	programs	T4
35	Application of NN	Learning control	T2,R1
36	Application of FLC	PID control	T1,R2
37	Application of GA	optimization	T4
38	Power systems	Major grid	T4
39	Power Electronic Systems	control	T4
40	Tool boxes	NN, FLC, GA	T4

X. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
I	S			H							S	H			S
II		S		H	H				S		H			S	S
III		S			H				S		S	H			S
IV	S			H					S			S		S	

V		S			H				S		H	H		S	

S=Supportive H=Highly related

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

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

S=Supportive H=Highly related

Prepared by: Dr. S. Vathsal professor