Course Outline for ETE-455

Part A

1. Course Code: ETE-455

2. Course Title: Neural and Fuzzy Systems in Communications

3. Course Type: Elective

4.Level/ Term: Level: 4 Term: II

5. Academic Session: 2019-20

6. Course Teacher: Eftekhar Hossain, Lecturer, Dept. of ETE, CUET

7. Prerequisite(s): None

8. Credits: 3

9. Contact Hours: 3 lectures of 50 minutes per week

10. Total Marks: 300

11. Rational of the Course:

This course will cover the basics of machine learning, deep learning and fuzzy logic for communications. This course will provide the knowledge on machine learning algorithms are applied for various applications such as regression, and classification; how neural network are proving superior compared to the traditional computer; how different neural networks algorithms are designed for specific applications; how fuzzy logic is used for industrial controlling; what is concept behind it. This is a required course for all the students enrolling B. Sc. Engg. in ETE program. The catalogue description of the course is

Course Content:

Fuzzy Logic Systems: Fuzzy Set Theory, Fuzzification, Fuzzy Rules, Defuzzification, Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Logic Control (FLC), Fuzzy Cognitive Maps.

Introduction to Fuzzy Logic Control. Foundations and Philosophy of Fuzzy Logic and Applications to Control Theory, Relationship between Classical PID Control and Fuzzy Rule-based Control, Techniques for Rule Construction and Adaptive Fuzzy Logic Controllers

Applications of FLC:Backing-up a Car, Backing up of a Tractor & Trailer.

Regression and Optimization: Least-squares Estimators, Derivative-based Optimization; Descent Methods, Steepest Descent Method, etc. Derivative-free Optimization; Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.
Neural Networks: Bidirectional Associative Memories, Adaptive Networks and Back Propagation, Supervised Learning; Perceptrons, Back Propagation Multilayer Perceptrons, Radial Basis Function NN,
Learning from Reinforcement, Temporal Difference Learning, Q-learning, Unsupervised Learning, Competitive Learning, Kohonen Self-organizing Networks, Hebbian Learning, Hopfield, Hardware of NN Architectures.
Applications of NN: NN Modeling of EM Fields, Pattern Recognition of Printed Character Recognition, Inverse Kinematics in Robotics.

12. Course Objectives:

(a) Introduce with the various neural network and fuzzy systems models.
(b) Introduce the theory and applications of artificial neural network and fuzzy systems to engineering applications with emphasis on image processing and control.
(c) Discuss complex neural networks and fuzzy systems, architectures, algorithms and their applications.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs

	Course Learning Outcomes (CLOs)	**Blooms Level (Optional)**
CLO1	Select appropriate neural network architectures for a given application (i.e. they shall recognize the class of applications and relate it to specific architectures).	
CLO2	Design and implement a neural network for domain specific applications.	
CLO3	Demonstrate knowledge and understanding of fuzzy system as they apply in engineering and science	

b) Mapping of CLO with PLO

No.	**(CLOs)**	**PLO 1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO 10**	**PLO 11**	**PLO 12**
1	CLO1		X										
2	CLO2			X									
3	CLO3	X											

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

`	Topic	Teaching-Learning Methodology	Assessment Method	Corresponding CLOs
Week-01	Introduction to Artificial Intelligence	Lecture with PPT	Not applicable	CLO-1
Week -02	Supervised Learning algorithms	Lecture with PPT	Test, exams, quiz, etc	CLO-1
Week -03	Linear Regression	Lecture with PPT	Test, exams, quiz, etc	CLO-1
Week -04	Logistic Regression	Lecture with PPT	Test, exams, quiz, etc	CLO-2
Week -05	Decision Tree, Random Forest, and Naïve Bayes	Lecture with PPT	Test, exams, quiz, etc	CLO-2
Week -06	SVM, KNN, Various Evaluation Measures	Lecture with PPT	Test, exams, quiz, etc	CLO-2
Week -07	Neural Network Basics	Lecture with PPT	Test, exams, quiz, etc	CLO-1
Week -08	Backpropagation Algorithm	Lecture with PPT	Test, exams, quiz, etc	CLO-2
Week -09	Unsupervised Learning	Lecture with PPT	Test, exams, quiz, etc	CLO-1
Week -10	SOM, Competitive Learning, RBNN	Lecture with PPT	Test, exams, quiz, etc	CLO-1

Week -11	Fuzzy logic Basics	Lecture with PPT	Test, exams, quiz, etc	CLO-3
Week -12	Fuzzification and Defuzzification Methods	Lecture with PPT	Test, exams, quiz, etc	CLO-3
Week -13	Fuzzy Inference Systems	Lecture with PPT	Test, exams, quiz, etc	CLO-3

Part C

15. Assessment and Evaluation

l) Assessment Strategy

Class participation and attendance Class tests/Class assessment Term Final Examination (3 hours duration)	10% 20% 70%
Total	100%

2) Marks distribution:

a) Continuous Assessment: 30%

b) Summative: 70%

c) Make-up Procedures:

- Feedback on continuous assessment is given to the students immediately after the test.
- The minimum number of class-test/assignment are (n+1) with best n will be counted (here, n is number of credit). Based on the students' feedback additional class-test/assignment may be taken by the course teacher

Part D

16. Learning Materials

1) Recommended Readings

- Artificial Intelligence A Guide to intelligent system

  Author: Michael Negnevitsky

2) Others

- Handout/lecture material provided by the course teacher