1. **Course Title:**
   Neural Networks & Fuzzy Systems

2. **Course Code:**
   EE4210

3. **Course Aims & Objectives:**
   This elective course aims at introducing the fundamental theory of neural networks and fuzzy systems. Various neural network and fuzzy models will be discussed. In particular, the learning and adaptation capability of neural and fuzzy systems will be emphasized. On completion of this course, students will be able to understand the principles of some commercial electronic products with neural or fuzzy control.

4. **Units:** 3

5. **Level:** B4

6. **Syllabus:**
   Introduction
   Characteristics of ANN and Fuzzy Systems, Biological Neuron, Artificial Neuron, Artificial Neural Networks, Phases in ANN Operation, Network Classification, Fuzzy sense in ANN

   Learning
   Unsupervised Learning, (Hebbian Learning, Competitive Learning & Boltzmann Learning), Supervised Learning (Error-Correction learning), Reinforcement Learning.

   Perceptrons
   Architecture of a Perceptron, Perceptron convergence algorithm, Generalized delta rule for weight adjustment

   Multilayer Perceptrons
   Theory of Backpropagation Training Algorithm, Rate of Learning, Training Considerations, Characteristics of BP Learning Algorithm, Limitations of BP Learning, Accelerated convergence of BP through learning-rate adaptation

   Recurrent Network
   Basic Concepts, Hopfield Network, Operation Features of Hopfield Network, Error Performance of Hopfield Network, Storage Capacity of Hopfield Network,

   Self-organizing Network
   Computational Maps in the Cerebral Cortex, Modification of Stimulus by Lateral Feedback, Self-organizing Feature-Mapping Algorithm, Properties of SOM algorithms, Examples of Feature Maps, Applications.

   Fuzzy Sets and Operations
   Fuzziness versus Randomness, Geometry of Fuzzy Sets : Sets as Points, Fuzzy entropy, Fuzzy subsethood theorem, Entropy subsethood theorem

   Fuzzy Associative Memories

Fuzzy Representation of Structured Knowledge, Fuzzy Associative Memories (FAM), Fuzzification, Fuzzy Association, Deffuzzification, Example: Inverted Pendulum, Practical Examples

7. **Teaching pattern:**
   Duration of course: 1 semester
   Suggested lecture/tutorial/laboratory mix: Lecture Hour: *26*
   Tutorial Hour: *13*
   Laboratory Hour: *0*

8. **Assessment pattern:**
   Examination duration: 2 hours, at the end of the semester
   Percentage of coursework, examination, etc.: 30% CW; *70%* Exam

   For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

9. **Pre-requisites:** *(please quote course code & title)*
   MA2149 Mathematical Analysis or
   MA2170 Linear Algebra and Multi-variable Calculus

10. **Pre-cursor:** *(please quote course code & title)*
    Nil

11. **Equivalent Courses:** *(please quote course code & title)*
    Nil

12. **Equivalent to the Old Course Code & Title**
    IT4401 Neural Networks & Fuzzy Systems

13. **Booklist:**
    Essential Reading
    S. Haykin, "Neural Networks: A Comphrehensive Foundation", 2nd Ed, Prentice-Hall (1999)

    B. Kosko, "Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence", Prentice-Hall (1992)

    Supplementary Reading
    P.D. Wasserman, "Neural Computing: Theory and Practice," van Nostrand Reinhold (1989)

    L. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications", Prentice-Hall (1994)

    H.J. Zimmermann, "Fuzzy Set Theory and its Applications", Klumer Academic (1991)