# Graphic Era
### HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhinyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

## End Term (EVEN) Semester Examination June 2025

Roll no.............................

Name of the Course and Semester: M.Tech. CSE & IV
Name of the Paper: Soft Computing
Paper Code: MCS 401

Maximum Marks: 100

**Note:**
- *(i)* All the questions are compulsory.
- *(ii)* Answer any two sub questions from a, b and c in each main question.
- *(iii)* Total marks for each question is 20 (twenty).
- *(iv)* Each sub-question carries 10 marks.

Q1.                                                                      (2X10=20 Marks)
a. Explain how Hebbian learning is used in modern AI applications. Discuss its advantages and limitations with real-life examples.                                          CO1
b. Design an ANN using McCulloch-Pitts neurons to implement a 3-bit majority function. Show all steps and logic.                                                                CO1
c. Critically analyze the delta learning rule and its convergence behavior in non-linearly separable datasets.                                                                CO1

Q2.                                                                      (2X10=20 Marks)
a. Compare and contrast Back Propagation Networks and Radial Basis Function Networks in terms of architecture and learning speed.                                          CO2
b. Describe the architecture and functioning of Self Organizing Maps (SOM). How can SOM be used for high-dimensional data clustering?                                      CO2
c. Design a feedback neural network using Hopfield architecture to solve the Travelling Salesman Problem. Illustrate your approach.                                        CO2

Q3.                                                                      (2X10=20 Marks)
a. Derive fuzzy union, intersection, and complement operations using Zadeh's operators. Use graphical representation for clarity.                                        CO3
b. Design a fuzzy rule base for controlling a smart home lighting system based on time of day and ambient brightness.                                                      CO3
c. Compare fuzzy cardinality with classical cardinality. How does it affect decision-making in real-world applications?                                                  CO3

Q4.                                                                      (2X10=20 Marks)
a. Differentiate between Mamdani and Takagi-Sugeno fuzzy inference systems. Give an industrial application for each.                                                      CO4
b. Explain fuzzification and defuzzification in detail using an example of a fuzzy controller for temperature regulation.                                                CO4
c. Construct a fuzzy system for medical diagnosis with a minimum of 3 fuzzy variables. Explain rules, inference mechanism, and output.                                  CO4

Q5.                                                                      (2X10=20 Marks)
a. Explain schema theorem and building block hypothesis with a numerical example.          CO5
b. Simulate a genetic algorithm for optimizing the function $f(x) = x^2$ in the range [0,31]. Perform at least 2 generations with crossover and mutation.                CO5
c. Discuss the theoretical foundation of genetic algorithms and compare them with traditional optimization techniques.                                                  CO5