Graphic Era HILL UNIVERSITY
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University under section 2(f) of UGC Act, 1956

End Term (ODD) Semester Examination November 2025

Roll no.....

Name of the Program and semester: BCA III AI &DS
Name of the Course: Introduction to Soft Computing
Course Code: TBD311

Time: 3 hours 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 the concept of Soft Computing. Discuss the key differences between Hard Computing and Soft Computing. Why is Soft Computing required in real-world problems where Hard Computing fails? Give two practical examples. (CO1)
b. Provide a comprehensive overview of various soft computing techniques, their applications, and the advantages they offer in handling complex and uncertain data and situations. (CO1)
c. Highlight the requirements and major application areas of soft computing, providing suitable examples. (CO1)

Q2. (2X10=20 Marks)

a. Explain the McCulloch-Pitts (M-P) neuron model in detail with its mathematical equation, block diagram and derive the truth table for a simple AND logic gate with inputs A=1, B=0. (CO1/CO2)
b. (i) Explain the Hebb learning rule for a neural network with the help of a flowchart and training algorithm. (CO2)

(ii) Draw the general architecture of a single artificial neuron. Discuss the various types of activation functions. (CO2)

c. Explain in detail the fundamental concepts of Artificial Neural Networks. Draw and label the structure of a biological neuron and an artificial neuron. Prepare a detailed comparison between a biological neuron and an artificial neuron (also highlight Brain vs Computer processing). (CO2)

Q3. (2X10=20 Marks)

a. Define Perceptron Networks and the Perceptron Learning Rule. What is the building block of a Perceptron? Explain the key points of perceptron networks in detail. (CO3)
b. Implement AND function using Perceptron Networks for bipolar inputs and targets. Show calculations for at least two complete epochs (or until no weight change occurs). (CO3)
c. Write short Note on: (CO3)

(i) BPN

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(ii) ADALINE

Q4.

a. What are Fuzzy Relations? Explain the Cartesian product of fuzzy sets and the Max-Min composition of two fuzzy relations. Explain the operations on fuzzy relations. (CO4)
b. Define the Membership function and state its importance in fuzzy logic. Discuss the Features of membership functions. Consider the following fuzzy set. (CO1/CO4)

$$B1 = \left\{\frac{0.1}{0} + \frac{0.2}{1} + \frac{0.3}{2} + \frac{0.4}{3} + \frac{0.5}{4}\right\}$$

$$B2 = \left\{\frac{0.5}{0} + \frac{0.4}{1} + \frac{0.3}{2} + \frac{0.2}{3} + \frac{0.1}{4}\right\}$$

Perform the following operations over the given fuzzy sets:

(i) $B1 \cup B2$ (ii) $B1 \cap \overline{B2}$ (iii) $B1|B2$ (iv) $\overline{B1 \cup B2}$ (iv) $B1 \cup B2$ (v) Algebraic Sum (vi) Bounded Difference

c. Write a short note on: CO4)

(i) FIS
(ii) crisp sets vs fuzzy sets
(iii) properties and operations of fuzzy sets with examples.

Q5. (2X10=20 Marks)

a. Define Genetic Algorithm. Explain how it is biologically inspired and state its main objective in optimization. With a neat flowchart, explain the complete working cycle of a standard Genetic Algorithm. (CO5)
b. Explain in detail any four selection methods used in Genetic Algorithms: (CO5)

(i) Roulette-Wheel Selection
(ii) Tournament Selection
(iii) Rank-Based Selection

For each method, write the mathematical principle, give one numerical example (assume population fitness: 10, 30, 5, 55), and state advantages/disadvantages. (CO1/CO5)

c. Describe the key elements of a Genetic Algorithm: encoding, crossover, and mutation. Illustrate a crossover and a mutation operation on two binary strings:

P1: 1100101 P2: 0011100 (CO5)