

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Theory Examination, May 2025

B. Tech. (All), Semester IV

Roll No.....

AS1113: Optimization for Computer Science

Time: 2.5 hours

Max. Marks: 40

Instructions to students:

1. Do not write anything other than your roll number on the question paper.
2. Use of non-programmable scientific calculator is allowed.
3. Be Neat! Be Legible!!All the Best!!!

Q1

Multiple choice questions with multiple correct answers

5*1.0

(CO1,2,3,4)

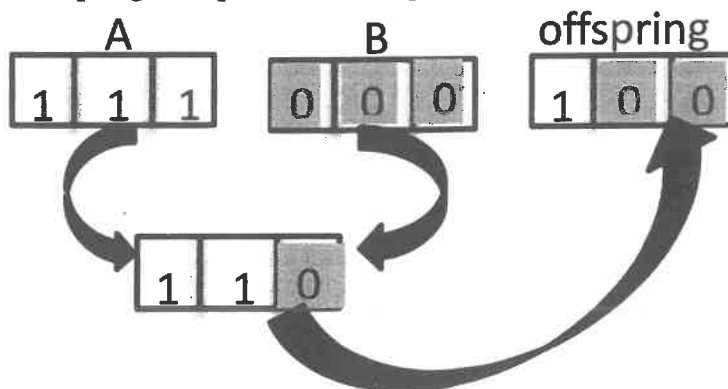
(i) Why is mutation essential even if crossover is used?

- A) Mutation always produces better solutions
- B) Crossover alone can lead to stagnation by losing gene diversity
- C) Mutation reduces computation time
- D) Crossover cannot be used for numeric optimization

(ii) Which of the following sets are convex sets-

- A) $S_1 = \{(x, y) : x^2 + y^2 \leq 4\}$
- B) $S_3 = \{(x, y) : x + 3y = 1\}$
- C) $S_2 = \{(x, y) : x^2 + y^2 = 4\}$
- D) $S_4 = \{(x, y, z) : 2x - 3y + z \leq 1\}$

(iii) Identify the biological processes (as per genetic algorithm) involved in the formation of a new offspring as depicted in the figure below



- A) mutation
- B) fitness evaluation
- C) crossover
- D) selection

(iv) A major drawback of the Steepest Descent method is:

- A) It requires second derivatives
- B) It may converge slowly

C) It is not applicable to non-linear functions

D) It requires a large amount of memory

(v) What is the primary requirement for applying the Golden Section Search method?

A) The function must be differentiable

B) The function must be unimodal

C) The function must be convex

D) The function must be linear

Q2 Define convex sets and convex functions with the help of appropriate examples. Prove that $|x|$ is a convex function.

2.0
(CO4)

Q3 Using the Fibonacci search method, find the minima and minimum value of the function $f(x) = x^2 - 6x + 15$. Conduct five iterations on the interval $[0,10]$.

7.0
(CO3)

Q4 Minimize $f(x_1, x_2) = 5x_1^2 + 4x_1x_2 + x_2^2 - 14x_1 - 6x_2 + 20$ using appropriate descent search technique with the initial point $X_1 = \begin{Bmatrix} 0 \\ 10 \end{Bmatrix}$.

5.0
(CO3)

Q5 The operations research team at a manufacturing company has developed the mathematical model for two of its manufactured products. They have identified the problem as a nonlinear programming (NLP) challenge, characterized by linear constraints and an objective function that combines both linear and quadratic elements. The relevant data compiled by the team is as follows:

7.0
(CO1)

$$\text{Maximize } Z = 7x^2 + 5y^2 + 6x$$

Subject to the constraints (i) $x + 2y \leq 10$, (ii) $x - 3y \leq 9$
and $x, y \geq 0$.

Find the optimal solution using KKT (Karush Kuhn Tucker) conditions.

Q6A A company has decided to introduce a product in three phases. Phase 1 will feature making a special offer at a greatly reduced rate to attract the first-time buyers. Phase 2 will involve intensive advertising to persuade the buyers to continue purchasing at a regular price. Phase 3 will involve a follow-up advertising and promotional campaign.

A total of Rs 5 million has been budgeted for this marketing campaign. If m is the market share captured in Phase 1, fraction f_2 of m is retained in Phase 2, and fraction f_3 of market share in Phase 2 is retained in Phase 3. The expected values of m , f_2 and f_3 at different levels of money expended are given below. How should the money be allocated to the three phases in order to maximize the final share?

7.0
(CO2)

Money Spent (Rs millions)	Effect on Market Share		
	m per cent	f_2	f_3
0	0	0.30	0.50
1	10	0.50	0.70
2	15	0.70	0.85
3	22	0.80	0.90
4	27	0.85	0.93
5	30	0.90	0.95

OR

- Q6B Use dynamic programming to show that: 7.0
 $Z = p_1 \log p_1 + p_2 \log p_2 + \dots + p_n \log p_n$ (CO2)
s.t. $p_1 + p_2 + \dots + p_n \leq 1$
and $p_1 + p_2 + \dots + p_i \geq 0, \forall i$
is minimum when $p_1 = p_2 = \dots = p_n = \frac{1}{n}$.

- Q7 Using Genetic Algorithms Maximize $f(x) = x^3 + x - 5$ over $x \in [0, 32]$ with initial x - 7.0
values $\{5, 14, 1, 23, 13, 30\}$. (CO4)
Derive two generations with one mutation in each generation.

