JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION-2025

B.Tech-IV Semester (CSE/IT)

COURSE CODE (CREDITS): 18B11CI413 (2) MAX. MARKS: 35

COURSE NAME: Modeling and Simulation Techniques

COURSE INSTRUCTORS: Dr. Vikas Baghel, Dr. Salman Raju Talluri MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.No	Question	CO	Marks
Q1	A student claims to have implemented a linear congruential generator (LCM) but forgot to record the multiplier a. You observe the following successive outputs: $K_0 = 217, K_1 = 2104, K_2 = 8987$ The full-period modulus and increment are known: $m = 9973,\ c = 351$. **a)** Determine the unknown multiplier a. **b)** Verify your a by generating K_3 and showing it satisfies the recurrence. **c)** If the student now changes c to 0 while keeping the same a and m what is the maximum possible period? Briefly justify.	[CO4]	[5]
Q2	Given the feasible set defined by: $x \geq 0, y \geq 0, z \geq 0$; $x + y + z = 1$ **(a)** Describe the geometric shape of this feasible set in $3D$ space. **(b)** Determine which point in the feasible set maximizes the objective function $x + 2y + 3z$, and explain your reasoning.	[CO5]	[2] [3]
Q3	Maximize the objective function $z = 3x_1 + 2x_2$ subject to the following constraints: $x_1 + x_2 \leq 4$; $2x_1 + x_2 \leq 5$; $x_1 \geq 0,\ x_2 \geq 0$ Use the simplex method to find the values of x_1 and x_2 that maximize z, and determine the maximum value of z.	[CO5]	[5]

Q4	Solve the following linear program using the Primal-Dual Interior-Point Algorithm: Maximize $2x_1 + x_2$ subject to $x_1 + x_2 = 2$ $x_1, x_2 \geq 0$ Given Initial Point: $$x^{(0)} = \begin{bmatrix}1\\1\end{bmatrix},\ s^{(0)} = \begin{bmatrix}1\\1\end{bmatrix},\ y^{(0)} = 3$$	[CO5]	[5]
Q5	a) Calculate the Hessian matrix for given function: $g(x) = -5\,x_1^2 + 3x_1x_2 + x_2^3 - x_3^2$. Comment on whether $g(x)$ is a quadratic function or not.	[CO3]	[2]
	b) Consider the function $f(x) = (2x-1)^2$. Verify the convexity of the function. Assume two points $x_1 = 1$ and $x_2 = 3$, and $\theta = 0.4$.		[3]
Q6	Consider a zero-sum game between two players: • **Player *X*** (the row player) chooses one of the rows. • **Player *Y*** (the column player) chooses one of the columns. The payoff matrix, which shows Player X's gain (and Player Y's loss), is $A = \begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}$. a) Explain how **Player X** calculates the maximin value and chooses an optimal strategy. b) Explain how **Player Y** calculates the minimax value and chooses an optimal strategy. c) Determine the optimal strategies x^* for **Player X** and y^* for **Player Y**.	[CO6]	[5]
Q7	a) What is the dual of the following problem: Maximize y_2 subject to $y_1 \geq 0,\ y_2 \geq 0$, $y1 + y2 \leq 3$?	[CO1]	[2]
	b) What is Taylor's Theorem? Explain its statement and significance in approximating functions.		[2]
	c) Explain the method of Lagrange multipliers for finding the extrema of a function subject to equality constraints.		[1]