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22STP104N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
MSc DEGREE EXAMINATION MAY 2025
(First Semester)
Branch - **STATISTICS**
OPERATIONS RESEARCH

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	Question	K Level	CO
1	Which of the following is a characteristic of a Mixed Integer Programming problem? a) All variables are integers. b) Some variables are integers, while others are continuous. c) All variables are continuous. d) The objective function is nonlinear.	K1	CO1
2	In the Dual Simplex Method, what happens when the dual problem has an unbounded solution? a) The primal problem has an optimal solution b) The primal problem has an unbounded solution c) The primal problem is infeasible d) The dual problem is infeasible	K2	CO1
3	Which of the following is a characteristic of a deterministic inventory problem without shortages? a) Demand is uncertain and varies over time b) Lead time is uncertain and varies over time c) Demand is constant and known with certainty d) Inventory levels can be negative	K1	CO2
4	Which of the following is a characteristic of Class A items in ABC analysis? a) Low value, low importance b) High value, high importance c) Medium value, medium importance d) Low value, high importance	K2	CO2
5	What is the primary goal of a queueing system? a) To minimize the average waiting time of customers b) To maximize the average waiting time of customers c) To minimize the average service time of customers d) To maximize the average service time of customers	K1	CO3
6	Which of the following is a characteristic of a Poisson arrival process? a) Arrivals occur at fixed intervals b) Arrivals occur in batches c) Arrivals occur randomly and independently d) Arrivals occur in a deterministic pattern	K2	CO3
7	Which of the following is a type of simulation used in project management? a) Monte Carlo simulation b) Discrete-event simulation c) Continuous simulation d) All of the above	K1	CO4
8	What is the critical path in a project? a) The sequence of tasks that determines the shortest possible time to complete the project b) The sequence of tasks that determines the longest possible time to complete the project c) The sequence of tasks that has the highest priority d) The sequence of tasks that has the lowest priority	K2	CO4
9	What is the main difference between linear programming and goal programming? a) Linear programming optimizes a single objective function, while goal programming optimizes multiple objective functions b) Linear programming satisfies multiple goals, while goal programming optimizes a single objective function c) Linear programming involves multiple goals, while goal programming involves a single goal d) None of these	K1	CO5
10	What is the primary objective of quadratic programming? a) To minimize a linear objective function subject to linear constraints b) To minimize a quadratic objective function subject to linear constraints c) To maximize a linear objective function subject to linear constraints d) None of these	K2	CO5

SECTION - B (35 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	Apply Dual simplex method to solve the following problem Minimize $z = 10x_1 + 6x_2 + 2x_3$ subject to the constraints $-x_1 + x_2 + x_3 \geq 1, 3x_1 + x_2 - x_3 \geq 2$.	K3	CO1
	(OR)		
11.b.	Find the optimum integer solution to the L.P.P Maximize $z = 4x_1 + 3x_2$ subject to the constraints $x_1 + 2x_2 \leq 4,\ 2x_1 + x_2 \leq 6,\ x_1, x_2 \geq 0$ and are integers.		
12.a.	Explain Deterministic inventory problem with and without shortage.	K5	CO2

Cont...

	(OR)		
12.b.	A product is to be manufactured on a machine. The cost, production and demand etc. are as follows: Fixed costs per lot = Rs. 30 Variable costs per lot = Rs. 0.10 Percentage charges for interest, taxes, insurance and storage = 50% Production rate = 1,00,000 units per year and demand rate = 10,000 units per year. Determine the economic manufacturing quantity.	K5	CO2
13.a.	A T.V repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in the order in which they came in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8-hour day, what is repairman's expected idle time each day? How many jobs are ahead of the average set just brought in?	K5	CO3
	(OR)		
13.b.	Four counters are being run on the frontier of a country to check the passports and necessary papers of the tourists. The tourists choose a counter at random. If the arrivals at the frontier is Poisson at the rate λ and the service time is exponential with parameter $\lambda/2$. What is the steady-state average queue at each counter?		
14.a.	After studying the weekly receipts and payments over the past 200 weeks a retailer has developed the following information: Weekly receipts (Rs.) / Probability: 3000 / 0.20; 5000 / 0.30; 7000 / 0.40; 12000 / 0.10 Weekly payments (Rs.) / Probability: 4000 / 0.30; 6000 / 0.40; 8000 / 0.20; 10000 / 0.10 Simulate the weekly pattern of receipts and payments for the 12 weeks of the next quarter, assuming a beginning bank balance is Rs. 8000. What is the estimated balance at the end of the 12weekly period?	K4	CO4
	(OR)		
14.b.	The following table gives the activities in a construction project and time duration: 1-2: - / 20 1-3: - / 25 2-3: 1-2 / 10 2-4: 1-2 / 12 3-4: 1-3, 2-3 / 5 4-5: 2-4, 3-4 / 10 Draw the activity network of the project and examine the total float and free float for each activity.		
15.a.	Determine the relative maximum and relative minimum values of the function $f(x) = 12x^5 - 4x^4 + 40x^3 + 5$.	K4	CO5
	(OR)		
15.b.	Solve the following NLPP by using Lagrangian multipliers: Minimize $Z = x_1^2 + x_2^2 + x_3^2$ subject to the constraints: $4x_1 + x_2^2 + 2x_3 = 14$		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Question No.	Question	K Level	CO
16	Evaluate the optimum solution to the L.P.P Maximize $z = 15x_1 + 45x_2$ subject to the constraints $x_1 + 16x_2 \le 240$, $5x_1 + 2x_2 \le 162$, $x_1 \le 50$; $x_1, x_2 \ge 0$ If maximum $z = \sum c_j x_j, j = 1,2$ and c_2 is kept fixed at 45, determine how much can c_1 be changed without affecting the optimal solution.	K5	CO1
17	Ten items kept in inventory by the school of Management are listed below. Which items should be classified as $'A'$ items, $'B'$ items and $'C'$ items? What is the percentage of items in each class? total and obtain the annual value is in each class? Item: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 Annual usage: 200, 100, 2000, 400, 6000, 1200, 120, 2000, 1000, 80 Value per unit (Rs): 40, 360, 0.20, 20, 0.04, 0.80, 100, 0.70, 1.00, 400	K4	CO2
18	Consider a single server queueing system with Poisson input, exponential service times. Suppose the mean arrival rate is 3 calling units per hour the expected service time is 0.25 hours and the maximum permissible number calling units in the system is two. Derive the steady-state probability distribution of the number of calling units in the system, and then test for the expected number in the system.	K4	CO3
19	Tasks $A, B, C, \ldots, H, I$ constitute a project. The notation $x < y$ means that the task x must e finished before y can begin. With this notation $A < D, A < E, B < F, D < F, C < G, C < H, F < I, G < I$. Draw a graph to represent the sequence of tasks and find the minimum time of completion of the project, when the time (in days) of completion of each task is as follows: Task: A, B, C, D, E, F, G, H, I Time: 8, 10, 8, 10, 16, 17, 18, 14, 9	K4	CO4
20	Estimate the optimal solution from the Kuhn-Tucker conditions, for the problem: Minimize $Z = 2x_1 + 3x_2 - x_1^2 - 2x_2^2$ subject to the conditions: $x_1 + 3x_2 \le 6, 5x_1 + 2x_2 \le 10\ x_1 \ge 0, x_3 \ge 0$.	K5	CO5

Z-Z-Z END