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22STP104N/ 22STP104

PSG COLLEGE OF ARTS & SCIENCE

(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2023

(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)

Module No.	Question No.	Question	K Level	CO
1	1	If the i^{th} constraint of a primal (maximisation) is equality, then the dual (minimisation) variable $y_i's$ is a. ≥ 0 b. ≤ 0 c. Unrestricted in sign d. None of the above	K1	CO1
	2	Mark the correct statement about integer programming problems (IPPs): a. Pure IPPs are those problems in which all the variables are non-negative integers. b. The 0-1 IPPS are those in which all variables are either 0 or all equal to 1. c. Mixed IPPS are those where decision variables can take integer value only by the slack / surplus variables can take fractional values as well. d. In real life, no variables can assume fractional values. Hence we should always use IPPs.	K2	CO1
2	3	In the context of ABC analysis, what does "C" represent? a. Critical items with high demand b. Items with moderate demand c. Items with low demand but high value d. Items with low demand and low value	K1	CO2
	4	In a deterministic inventory model without shortages, what is the primary assumption regarding demand? a. Demand is known with certainty and constant. b. Demand follows a random pattern c. Demand can exceed the order quality d. Demand is not considered in this model	K2	CO2
3	5	In a queuing system, what is the term "service rate" referring to a. the number of customers waiting in the queue b. the average time consumers spend in the system c. the rate at which customers are served by the system d. the total time the system operators in a day	K1	CO3
	6	Which of the following factors does not influence the behaviour of a queuing system? a. Arrival rate of customers b. Service rate of the system c. Length of the queue d. Operating hours of the system	K2	CO3

Cont...

4	7	What does the "Forward Pass" in network analysis aim to determine? a. the latest start time for each activity b. the earliest start and finishing time for each activity c. the critical path of the project d. the number of resources required for each activity	K1	CO4
	8	In a Monte Carlo simulation, what is the role of a "Random number generator"? a. To generate truly random numbers b.To ensure that the simulation results are always predictable c. To produce pseudo-random numbers used for sampling d. To provide a fixed set of numbers for all simulations	K2	CO4
5	9	Which of the following is an example of a nonlinear constraint in programming? a. $2x + 3y = 6$ b. $4x - 3y \leq 0$ c. $3y \geq 12$ d. $3x^2 - y^2 \leq 25$	K1	CO5
	10	In goal programming, what are "deviation variables" used for? a. To add extra constraints to the problem b. To measure the difference between achieved and desired goals c. To introduce nonlinear objectives d. To adjust the coefficient in the objective function	K2	CO5

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Compare and contrast mixed integer programming (MIP) with pure integer programming (PIP). Highlights the advantages and limitations of MIP Models, especially when both discrete and continuous decision variables are involved.	K3	CO1
		(OR)		
	11.b.	Perform the Dual simplex method for the given linear programming problem, showing all the relevant tableau iterations and explaining each step in the solution process. Determine the optimal solution and optimal value of the objective function. $Max\ Z = 3x_1 + 2x_2$ *Subject to*: $2x_1 + x_2 \leq 6$ $x_1 + 2x_2 \leq 4$ $x_1, x_2 \geq 0$		
2	12.a.	Elaborate on the details of ABC analysis, outlining the methodology used for classify inventory items into A, B and C categories.	K4	CO2
		(OR)		
	12.b.	A producer has to supply 12,000 units of a product per year to his customer. The demand is fixed and known and backlogs are not allowed. The inventory holding cost is Rs. 0.20 per unit per month and the set-up cost per run is Rs. 350/- per run. Determine a) the optimal lot size, b) the optimum scheduling period and c) the minimum total expected yearly cost.		

3	13.a.	In a self-service store with one cashier, 8 customers arrive on an average of every 5 mins and the cashier can serve 10 in 5 mins. If both arrival and service time are exponentially distributed then determine a. Average number of customers waiting time in the queue for average. b. Expect waiting time in the queue. c. What is the probability of having more than 6 customers in the system?	K4	CO3
	(OR)			
	13.b.	Highlight the practical significance of using the (M | M | 1): (N | FIFS) model in these real-world applications. Explain how the insights derived from this model contribute to the improvement of system performance, resource allocation, or informed decision-making.		
4	14.a.	Highlight the advantages and disadvantages of simulation, including challenges in data gathering, model validation, and the potential for misinterpretation of results.	K5	CO4
	(OR)			
	14.b.	Offer an in-depth explanation of the foundational rules, guidelines, and prevalent errors associated with the creation of network diagrams in project management and network analysis.		
5	15.a.	In the domain of advanced optimization, provide a comprehensive analysis of Quadratic Programming (QP) by exploring its intricate details and practical applications.	K5	CO5
	(OR)			
	15.b.	In advanced optimization theory, delve into the complexities of constrained maxima and minima problems.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

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

Module No.	Question No.	Question	K Level	CO
1	16	In the context of Integer Programming, delve into the post-optimal analysis, which is crucial for understanding the sensitivity and stability of solutions.	K3	CO1
2	17	a. State the step-by-step procedure of ABC analysis. b. Classify the following materials into A, B and C groups.	K4	CO2

Item No.	1	2	3	4	5
Annual Usage (in Rs. X 1000)	36	14	75	37	11

Item No.	6	7	8	9	10
Annual Usage (Rs. X 1000)	16	32	08	95	04

<table>
<tr><td>3</td><td>18</td><td>For a $(M \mid M \mid 1):(\infty \mid FIFO)$ queuing model in the steady state case, obtain the expression for the mean and variance of queuing length in terms of relevant parameters λ and μ.</td><td>K4</td><td>CO3</td></tr>
<tr><td>4</td><td>19</td><td>A small project consisting of eight activities has the following characteristics.
<table>
<tr><th>Activity</th><th>Preceding Activity</th><th>Most optimistic time</th><th>Most likely time</th><th>Most pessimistic time</th></tr>
<tr><td>A</td><td>-</td><td>2</td><td>4</td><td>12</td></tr>
<tr><td>B</td><td>-</td><td>10</td><td>12</td><td>26</td></tr>
<tr><td>C</td><td>A</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>D</td><td>A</td><td>10</td><td>15</td><td>20</td></tr>
<tr><td>E</td><td>A</td><td>7</td><td>7.5</td><td>11</td></tr>
<tr><td>F</td><td>B, C</td><td>9</td><td>9</td><td>9</td></tr>
<tr><td>G</td><td>D</td><td>3</td><td>3.5</td><td>7</td></tr>
<tr><td>H</td><td>E, F, G</td><td>5</td><td>5</td><td>5</td></tr>
</table>
a. Draw the PERT network diagram.
b. Prepare the activity schedule for the project.
c. Determine the critical path.
d. If a 30–week deadline is imposed, what is the probability that the project will be finished within the time limit?</td><td>K5</td><td>CO4</td></tr>
<tr><td>5</td><td>20</td><td>Explain the Kuhn-Tucker (KT) method in the context of constrained optimization for nonlinear programming problems.</td><td>K5</td><td>CO5</td></tr>
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Z-Z-Z END