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22CAP213N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MCA DEGREE EXAMINATION MAY 2025
(Second Semester)

Branch – **COMPUTER APPLICATIONS**

MATHEMATICAL OPTIMIZATION

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	In an Linear Programming Problem functions to be maximized or minimized are called------- a) constraints b) objective function c) basic solution d) feasible solution	K1	CO1
	2	The coefficient of slack\surplus variables in the objective function are always assumed to be --- a) 0 b) 1 c) M d) – M	K2	CO1
2	3	In a transportation problem, we must make the number of ------- and ------- equal. a) destinations; sources b) units supplied; units demanded c) columns; rows d) positive cost coefficients; negative cost coefficients	K1	CO2
	4	The assignment problem is a special case of transportation problem in which -------. a) number of origins are less than the number of destinations b) number of origins are greater than the number of destinations c) number of origins are greater than or equal to the number of destinations d) number of origins equals the number of destinations	K2	CO2
3	5	An activity which does not consume neither any resource nor time is known as ----------. a) predecessor activity b) successor activity c) dummy activity d) activity	K1	CO3
	6	---------- is employed in construction and business problems. a) queue b) replacement c) CPM d) PERT	K2	CO3
4	7	Which of the following criterion is not used for decision-making under uncertainty? a) maximin b) maximax c) minimax d) minimize expected loss	K1	CO4
	8	In game theory, the outcome or consequence of a strategy is referred to as the-------- a) payoff b) penalty c) reward d) end-game strategy	K2	CO4
5	9	Number of customers in the queue per unit of time is called ------- a) queuing system b) length of queue c) average length of queue d) none of these	K1	CO5
	10	In queuing theory, --------- stands for mean arrival rate of customers. a) μ b) λ c) t d) none of these	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

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

<table>
<tr><th>Module No.</th><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td rowspan="3">1</td><td>11.a.</td><td>Solve the following LPP by using the Two-Phase method:
$maximize\ z = 3x_1 - x_2$
Subject to
$2x_1 + x_2 \geq 2$
$x_1 + 3x_2 \leq 2$
$x_2 \leq 4$
$and\ x_1 \geq 0, x_2 \geq 0$</td><td rowspan="3">K3</td><td rowspan="3">CO1</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>11.b.</td><td>Consider the following LPP:
$maximize\ z = 2x_1 + 3x_2$
Subject to
$x_1 + 3x_2 \leq 12$
$3x_1 + 2x_2 \leq 12$
$x_1, x_2 \geq 0$
Show how the infeasible basic solutions are represented on the graphical solution space.</td></tr>
<tr><td rowspan="3">2</td><td>12.a.</td><td>Determine an initial basic feasible solution to the following transportation problem using north-west corner rule:
<table>
<tr><td></td><td></td><td>To</td><td></td><td></td><td>Available</td></tr>
<tr><td></td><td>3</td><td>4</td><td>6</td><td>8</td><td>9</td><td>20</td></tr>
<tr><td></td><td>2</td><td>10</td><td>1</td><td>5</td><td>8</td><td>30</td></tr>
<tr><td>From</td><td>7</td><td>11</td><td>20</td><td>40</td><td>3</td><td>15</td></tr>
<tr><td></td><td>2</td><td>1</td><td>9</td><td>14</td><td>16</td><td>13</td></tr>
<tr><td>Demand</td><td>40</td><td>6</td><td>8</td><td>18</td><td>6</td><td></td></tr>
</table></td><td rowspan="3">K3</td><td rowspan="3">CO2</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>12.b.</td><td>Find the optimal assignment for the assignment problem with the following cost matrix:
<table>
<tr><td></td><td>I</td><td>II</td><td>III</td><td>IV</td></tr>
<tr><td>A</td><td>5</td><td>3</td><td>1</td><td>8</td></tr>
<tr><td>B</td><td>7</td><td>9</td><td>2</td><td>6</td></tr>
<tr><td>C</td><td>6</td><td>4</td><td>5</td><td>7</td></tr>
<tr><td>D</td><td>5</td><td>7</td><td>7</td><td>6</td></tr>
</table></td></tr>
<tr><td rowspan="3">3</td><td>13.a.</td><td>Discuss network construction.</td><td rowspan="3">K3</td><td rowspan="3">CO3</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>13.b.</td><td>The precedence relationships for the activities of a project are given below. Draw the network.
<table>
<tr><th>Activity</th><th>Immediate predecessor</th><th>Activity</th><th>Immediate predecessor</th></tr>
<tr><td>A</td><td>-</td><td>G</td><td>B,C</td></tr>
<tr><td>B</td><td>-</td><td>H</td><td>C</td></tr>
<tr><td>C</td><td>-</td><td>I</td><td>E,F</td></tr>
<tr><td>E</td><td>A</td><td>J</td><td>G,H</td></tr>
<tr><td>F</td><td>A,B</td><td>K</td><td>H</td></tr>
</table></td></tr>
<tr><td rowspan="3">4</td><td>14.a.</td><td>Write down the decision-making under conditions of certainty.</td><td rowspan="3">K3</td><td rowspan="3">CO4</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>14.b.</td><td>Find the ranges of values of p and q which will render the entry (2,2) a saddle point for the game.
<table>
<tr><td></td><td></td><td>Player B</td><td></td></tr>
<tr><td></td><td></td><td>B_1</td><td>B_2</td><td>B_3</td></tr>
<tr><td></td><td>A_1</td><td>2</td><td>4</td><td>5</td></tr>
<tr><td>Player A</td><td>A_2</td><td>10</td><td>7</td><td>Q</td></tr>
<tr><td></td><td>A_3</td><td>4</td><td>P</td><td>6</td></tr>
</table></td></tr>
</table>

5	15.a.	A community is served by two cab companies. Each company owns two cabs, and both share the market equally, with call arriving at each company's dispatching office at the average rate of 8 per hour. The average time per ride is 12 minutes. Calls arrive according to a Poisson distribution, and the ride time is exponential. The two companies have bought by an investor and will be consolidated into a single dispatching office. Analyze the new owner's proposal.	K3	CO5
		(OR)		
	15.b.	Discuss the elements of a queuing model.		

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	Solve the following LPP by simple method: $maximize\ z = 5x_1 + 4x_2$ Subject to $6x_1 + 4x_2 \leq 24$ $x_1 + 2x_2 \leq 6$ $-x_1 + x_2 \leq 1$ $x_2 \leq 2$ $x_1, x_2 \geq 0$	K4	CO1
2	17	Solve the following transportation problem using Vogel's method in order to minimize to total transportation cost: Mill 1: 10, 2, 20, 11 — Supply **15** Silo 2: 12, 7, 9, 20 — Supply **25** 3: 4, 14, 16, 18 — Supply **10** Demand: **5**, **15**, **15**, **15**	K4	CO2
3	18	Activity: 1-2, 2-3, 2-4, 3-5, 4-5, 4-6, 5-7, 6-7, 7-8, 7-9, 8-10, 9-10 t_o(weeks): 1, 1, 1, 3, 2, 3, 4, 6, 2, 5, 1, 3 t_p(weeks): 5, 3, 5, 5, 4, 7, 6, 8, 6, 8, 3, 7 t_m(weeks): 1.5, 2, 3, 4, 3, 5, 5, 7, 4, 6, 2, 3 Construct a PERT NETWORK. Find the critical path and variance for each event. Find the project duration at 95% probability.	K4	CO3
4	19	A steel manufacturing company is concerned with the possibility of a strike. It will cost an extra Rs. 20000 to acquire an adequate stockpile. If there is a strike and the company has not stockpiled, management estimates an additional expense of Rs. 60000 on account of lost sales. Should the company stockpile or not if it is to use. i) Optimistic criterion ii) Wald criterion iii) Savage criterion iv) Hurwiez criterion for $\alpha = 0.4$ v) Laplace criterion?	K4	CO4
5	20	Automata car wash is a one-bay facility, cars arrive according to a Poisson distribution with a mean of 4 cars per hour and may wait in the facility's parking lot or on the street bordering the wash facility if the bay is busy. The time for washing and cleaning a car is exponential, with a mean of minutes. This means that, for all practical purpose, there is no limit on the size of the system. the manager of the facility wants to determine the size of the parking lot. Determine it.	K4	CO5

Z-Z-Z END