PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc(SS) DEGREE EXAMINATION MAY 2025
(Fourth Semester)

Branch – **SOFTWARE SYSTEMS (Five Year Integrated)**

OPTIMIZATION TECHNIQUES

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	A feasible solution to an LPP _____. a) Must satisfy all of the problem's constraints simultaneously b) Must be a corner point of the feasible region c) Need not satisfy all of the constraints only some of them d) Must optimize the value of the objective function	K1	CO1
	2	A necessary and sufficient condition for a basic feasible solution to a minimization LPP to be an optimum is that (for all j) _____. a) $z_j - c_j \geq 0$ b) $z_j - c_j \leq 0$ c) $z_j - c_j = 0$ d) $z_j - c_j > 0$ *or* $z_j - c_j < 0$	K2	CO1
2	3	The solution to a transportation problem with m-sources and n-destinations is feasible, if the number of allocations are____. a) $m + n - 1$ b) $m + n + 1$ c) $m + n$ d) $m \times n$	K1	CO2
	4	The assignment problem is a special case of transportation problem in which number of origins are _____. a) Equals the number of destinations b) Greater than the number of destinations c) Less than the number of destinations d) Less than or equal to the number of destinations	K2	CO2
3	5	A two person game is said to be zero-sum, if _____. a) Gain of one player is exactly matched by a loss to the other so that their sum is equal to zero b) Gain of one player does not match the loss to the other c) Both the players must have an equal number of strategies d) Diagonal entries of the pay-off matrix are zero	K1	CO2
	6	When maximin and minimax values of the game are same, then _____. a) There is a saddle point b) Solution does not exist c) Strategies are mixed d) None of the above	K2	CO3
4	7	When there are more than one serves, customer behaviour in which he moves from one queue to another is known as_____. a) Balking b) Jockeying c) Reneging d) Alternating	K1	CO4
	8	Priority queue discipline may be classified as_____. a) Finite or infinite b) Limited or unlimited c) Pre-emptive or non pre-emptive d) All of the above	K2	CO4
5	9	In critical path analysis, the word CPM mean_____. a) Critical path method b) Crash project management c) Critical project management d) Critical path management	K1	CO5
	10	The objective of network analysis is to_____. a) Minimize total project cost b) Minimize total project duration c) Minimize production delays, interruption and conflicts d) All of the above	K2	CO5

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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>An electronic company is engaged in the production of two components C_1 and C_2used in $T.V.$ sets. Each unit of C_1 costs the company Rs.25 in wages and RS.25 in material, while each unit of C_2 costs the company Rs.125 in wages and Rs.75 in material. The company sells both products on one-period credit terms, but the company's labour and material expenses must be paid in cash. The selling price of C_1 is Rs.150 per unit and of C_2 is Rs.350 per unit. Because of the strong monopoly of the company for this components, it is assumed that the company can sell at the prevailing prices as many units as it produces. The company's production capacity is, however, limited by two considerations. First, at the beginning of period 1, the company has an initial balance of Rs.20,000 (cash plus bank credit plus collections from past credit sales). Second, the company has available in each period 4,000 hours of machine tie and 2,800 hours of assembly time. The production of each C_1 requires 6 hours of machine time and 4 hours of assembly time, whereas the production of each C_2 requires 4 hours of machine time and 6 hours of assembly time. Formulate this problem as a Linear Programming model so as to maximize the total profit to the company.</td><td>K3</td><td>CO1</td></tr>
<tr><td colspan="3">(OR)</td></tr>
<tr><td>11.b.</td><td>Use the graphical method to solve the following LPP :
Minimize $z = -x_1 + 2x_2$;
subject of the constraints :
$-x_1 + 3x_2 \leq 10, x_1 + x_2 \leq 6,$
$x_1 - x_2 \leq 2, and\ x_1 \geq 0, x_2 \geq 0.$</td><td></td><td></td></tr>
<tr><td rowspan="3">2</td><td>12.a.</td><td>Use Vogel's approximation method to obtain an initial basic feasible solution of the transportation problem :
<table>
<tr><th></th><th>D</th><th>E</th><th>F</th><th>G</th><th>Available</th></tr>
<tr><td>A</td><td>11</td><td>13</td><td>17</td><td>14</td><td>250</td></tr>
<tr><td>B</td><td>16</td><td>18</td><td>14</td><td>10</td><td>300</td></tr>
<tr><td>C</td><td>21</td><td>24</td><td>13</td><td>10</td><td>400</td></tr>
<tr><td>Demand</td><td>200</td><td>225</td><td>275</td><td>250</td><td></td></tr>
</table></td><td rowspan="3">K3</td><td rowspan="3">CO2</td></tr>
<tr><td colspan="3">(OR)</td></tr>
<tr><td>12.b.</td><td>A departmental head has four subordinates, and four tasks to be performed. The subordinates differ in efficiency, and the tasks differ in their intrinsic difficulty. His estimate, of the time each man would take to perform each task, is given in the matrix below :
<table>
<tr><th rowspan="2">Tasks</th><th colspan="4">Men</th></tr>
<tr><th>E</th><th>F</th><th>G</th><th>H</th></tr>
<tr><td>A</td><td>18</td><td>26</td><td>17</td><td>11</td></tr>
<tr><td>B</td><td>13</td><td>28</td><td>14</td><td>26</td></tr>
<tr><td>C</td><td>38</td><td>19</td><td>18</td><td>15</td></tr>
<tr><td>D</td><td>19</td><td>26</td><td>24</td><td>10</td></tr>
</table>
How should the tasks be allocated, one to man, so as to minimize the total man-hours?</td></tr>
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3	13.a.	Determine the range of value of p *and* q that will make the payoff element a_{22}, a saddle point for the game whose payoff matrix (a_{ij}) is given below : $$\begin{matrix} & Player\ B \\ Player\ A & \begin{bmatrix} 2 & 4 & 7 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{matrix}$$	K3	CO3
		(OR)		
	13.b.	Obtain the optimal strategies for both – persons and the value of the game for zero-sum two-person game whose payoff matrix is as follows : $$\begin{bmatrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \\ 4 & 1 \\ 2 & 2 \\ -5 & 0 \end{bmatrix}$$		
4	14.a.	In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following : i. The mean queue size (line length), and ii. The probability that the queue size exceeds 10. If the input of trains increases to an average 33 per day, what will be the change in (i) and (ii)?	K4	CO4
		(OR)		
	14.b.	At a railway station, only one train is handled at a time. The railway yard is sufficient only for two trains to wait while other is given signal to leave the station. Trains arrive at the station at an average rate of 6 per hour and the railway station can handle them on an average of 12 per hour. Assuming Poisson arrivals and exponential service distribution, find the steady-state probabilities for the various number of trains in the system. Also find the average waiting time of a new train coming in to the yard.		
5	15.a.	Write down the rules for constructing the network.	K3	CO5
		(OR)		
	15.b.	Draw a network diagram for the following data : Activity : A B C D E F G H I J Preceding activity: - A A B A B, E C D, F G H, I		

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	Use simplex method to solve the following LPP : *Maximize* $z = 4x_1 + 10x_2$ *subject to the constraints* : $2x_1 + x_2 \leq 50, 2x_1 + 5x_2 \leq 100,$ $2x_1 + 3x_2 \leq 90; x_1 \geq 0$ *and* $x_2 \geq 0.$	K4	CO1
2	17	Find the starting solution in the following transportation problem by Vogel's Approximation Method. Also obtain the optimum solution : D_1 D_2 D_3 D_4 Supply S_1 3 7 6 4 5 S_2 2 4 3 2 2 S_3 4 3 8 5 3 Demand 3 3 2 2	K4	CO2

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3	18	Two firms are competing for business under the conditions so that one firm's gain is another firm's loss. Firm A's payoff matrix is given below. $$\begin{array}{cc} & \begin{matrix} \text{No ad} & \text{Medium ad} & \text{Heavy ad} \end{matrix} \\ \begin{matrix} \text{Firm A} \\ \text{No advertising} \\ \text{Medium advertising} \\ \text{Heavy advertising} \end{matrix} & \begin{bmatrix} 10 & 5 & -2 \\ 13 & 12 & 15 \\ 16 & 14 & 10 \end{bmatrix} \end{array}$$	K5	CO3
4	19	A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distribution for both deposits and withdrawals is exponential with mean service time 3 minutes per customer. Depositors are found to arrive in Poisson fashion throughout the day with mean arrival rate of 16 per hour. Withdrawers also arrive in Poisson fashion with mean arrival rate of 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits? What could be the effect if this could be accomplished by increasing the mean service time to 3.5 minutes?	K5	CO4
5	20	A small project is composed of seven activities whose time estimates are listed in the table as follows: Activity | Estimated duration (weeks) i | j | Optimistic | Most likely | Pessimistic 1 | 2 | 1 | 1 | 7 1 | 3 | 1 | 4 | 7 1 | 4 | 2 | 2 | 8 2 | 5 | 1 | 1 | 1 3 | 5 | 2 | 5 | 14 4 | 6 | 2 | 5 | 8 5 | 6 | 3 | 6 | 15 a) Draw the project network. b) Find the expected duration and variance of each activity. What is the expected project length? c) Calculate the variance and standard deviation of project length. What is the probability that the project will be completed: i. At least 4 weeks earlier than expected ? ii. No more than 4 weeks later than expected ? d) If the project due date is 19 weeks, what is the probability of meeting the due date? Given: | z | 0.50 | 0.67 | 1.00 | 1.33 | 2.00 p | 0.3085 | 0.2514 | 0.1587 | 0.0918 | 0.0228	K6	CO5

Z-Z-Z END