PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

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

Branch – **SOFTWARE SYSTEMS (Five Years 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	If two constraints do not intersect in the positive quadrant of the graph, then a) One of the constraints is redundant b) The solution is infeasible c) The solution is unbounded d) None of these	K1	CO1
	2	Given a system of m simultaneous linear equations in n unknowns $(m < n)$, the number of basic variables will be a) m b) n c) $n-m$ d) $n+m$	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	An assignment problem is considered as a particular case of transportation problem, because a) All the rim conditions are 1 b) All x_{ij} are either 1 or 0 c) The number of rows equals columns d) All of the above	K2	CO2
3	5	For a two person zero-sum game, the value of game can be a) Determined only if the pay-off matrix has a saddle point b) Positive, negative or zero c) Determined inly if the game is fair d) None of the above	K1	CO3
	6	A game is said to be fair, if a) Upper value is more than lower value of the game b) Upper and lower values of the game are not equal c) Upper and lower values of the game are same and zero d) None of the above	K2	CO3
4	7	Queue can form only when a) Arrivals exceed service capacity b) Arrivals equals service capacity c) Service facility is capable to serve all the arrivals at a time d) There are more than one service facilities	K1	CO4
	8	Multiple servers may be a) in parallel b) in series c) in combination of parallel and series d) All of the above	K2	CO4
5	9	Network problems have advantage in terms of project a) Scheduling b) Planning c) Controlling d) All of the above	K1	CO5
	10	In critical path analysis, the word *CPM* mean a) Critical path method b) Crash project management c) Critical project management d) Critical path management	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.	An agriculturist has a farm with 125 acres. He produces Radish, Muttar and Potato. Whatever he raises is fully sold in the market. He gets Rs 5 for Radish per kg Rs 4 for Muttar and Rs 5 for Potato per kg. The average yield is 1,500 kg of Radish per acre 1,800 kg of Muttar per acre and 1,200 kg of Potato per acre. To produce each 100 kg of Raddish, Muttar and 80 kg of Potato a sum of Rs 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for Raddish and Potato each and 5 man-days for Muttar . A total of 500 man days of labour at a rate of Rs 40 per man day are available. Formulate this as a Linear Programming model to maximize the agriculturist's total profit.	K2	CO1
		(OR)		

Cont...

	11.b.	Use the graphical method to solve the following LPP : Maximize $z = 2x_1 + 3x_2$; subject to the constraints : $x_1 + x_2 \leq 30, x_1 - x_2 \geq 0, x_2 \geq 3$ $0 \leq x_1 \leq 20$ *and* $0 \leq x_2 \leq 12$.	K2	CO1
2	12.a.	Obtain an initial basic feasible solution to the following transportation problem using the north-west corner rule : D: 11, 16, 21, 200 — E: 13, 18, 24, 225 — F: 17, 14, 13, 275 — G: 14, 10, 10, 250 — Available: 250, 300, 400 — Requirement	K3	CO2
		(OR)		
	12.b.	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 : Tasks: A, B, C, D — Men E: 18, 13, 38, 19 — F: 26, 28, 19, 26 — G: 17, 14, 18, 24 — H: 11, 26, 15, 10 How should the tasks be allocated, one to man, so as to minimize the total man-hours?		
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 : $\begin{matrix} \\ Player\ A \end{matrix} \begin{matrix} Player\ B \\ \begin{bmatrix} 2 & 4 & 7 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{matrix}$	K3	CO3
		(OR)		
	13.b.	For the game with the following payoff matrix, determine the optimum strategies and the value of the game : $\begin{matrix} \\ P_1 \end{matrix} \begin{matrix} P_2 \\ \begin{bmatrix} 5 & 1 \\ 3 & 4 \end{bmatrix} \end{matrix}$		
4	14.a.	On an average 96 patients per 24-hours day require the service of an emergency clinic. Also on the average a patient requires 10 minute of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs.100 per patient treated to obtain an average servicing time of 10 minute, and that each minute of decrease in this average time would cost Rs.10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to $\frac{1}{2}$ a patient.	K4	CO4
		(OR)		
	14.b.	Assume that the goods trains are coming in a yard at the rate of 30 trains per day and suppose that the inter- arrival times follow exponential distribution. The service time for each train is assumed to be exponential with an average of 36 minutes. If the yard can admit 9 trains at a time (there being 10 lines, one of which is reserved for shunting purpose), calculate the probability that the yard is empty and find the average queue length.		
5	15.a.	Write down the rules for constructing the network.	K4	CO5
		(OR)		
	15.b.	Construct the network diagram comprising activities $B, C, \ldots, Q$ *and* N such that the following constraints are satisfied : $B < E, F; C < G, L; E, G < H; L, H < I; L < M; H < N; H < J; I, J < P; P < Q$. The notation $X < Y$ means that the activity X must be finished before Y can begin.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks $(3 \times 10 = 30)$

Module No.	Question No.	Question	K Level	CO
1	16	Use simplex method to solve the following LPP : *Minimize* $z = x_2 - 3x_3 + 2x_5$ *subject to the constraints* : $3x_2 - x_3 + 2x_5 \leq 7, -2x_2 + 4x_3 \leq 12,$ $-4x_2 + 3x_3 + 8x_5 \leq 10; x_2 \geq 0,$ $x_3 \geq 0$ *and* $x_5 \geq 0$.	K4	CO1

Cont...

<table>
<tr><td>2</td><td>17</td><td>Given $x_{13} = 50\ units, x_{14} = 20\ units, x_{21} = 55\ units, x_{31} = 30\ units, x_{32} = 35\ units\ and\ x_{34} = 25\ units$. Is it an optimal solution to the transportation problem.
$$\begin{matrix} & & & & \textit{Available units} \\ \begin{bmatrix} 6 & 1 & 9 & 3 \\ 11 & 5 & 2 & 8 \\ 10 & 12 & 4 & 7 \end{bmatrix} & & & & \begin{matrix} 70 \\ 55 \\ 90 \end{matrix} \\ \textit{Required units}: 85 & 35 & 50 & 45 & \end{matrix}$$
If not, modify it to obtain feasible solution.</td><td>K4</td><td>CO2</td></tr>
<tr><td>3</td><td>18</td><td>Solve the following game :
$$\begin{matrix} & & \textit{Player B} & & & \\ & & I & II & III & IV \\ \textit{Player A} & I & \begin{bmatrix} 3 & 2 & 4 & 0 \\ 3 & 4 & 2 & 4 \\ 4 & 2 & 4 & 0 \\ 0 & 4 & 0 & 8 \end{bmatrix} \\ & II & & & & \\ & III & & & & \\ & IV & & & & \end{matrix}$$</td><td>K5</td><td>CO3</td></tr>
<tr><td>4</td><td>19</td><td>A supermarket has two persons serving at the counters. The customers arrive in a Poisson fashion at the rate of 12 per hour. The service time for each customer is exponential with a mean of 6 minutes.
Find (i) the probability that an arriving customer has to wait for service (ii) The average number of customers in the system, and (iii) The average time spent by a customer in the supermarket.</td><td>K6</td><td>CO4</td></tr>
<tr><td>5</td><td>20</td><td>A project consist of eight activities with the following relevant information:
<table>
<tr><th rowspan="2">Activity</th><th rowspan="2">Immediate predecessor</th><th colspan="3">Estimated duration (weeks)</th></tr>
<tr><th>Optimistic</th><th>Most likely</th><th>Pessimistic</th></tr>
<tr><td>A</td><td>-</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td>B</td><td>-</td><td>1</td><td>4</td><td>7</td></tr>
<tr><td>C</td><td>-</td><td>2</td><td>2</td><td>8</td></tr>
<tr><td>D</td><td>A</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>E</td><td>B</td><td>2</td><td>5</td><td>14</td></tr>
<tr><td>F</td><td>C</td><td>2</td><td>5</td><td>8</td></tr>
<tr><td>G</td><td>D, E</td><td>3</td><td>6</td><td>15</td></tr>
<tr><td>H</td><td>F, G</td><td>1</td><td>2</td><td>3</td></tr>
</table>
(i) Draw the PERT network and find out the expected project completion time.
(ii) What duration will have 95% confidence for project completion?
(iii) If the average duration for activity F increases to 14 days, what will be its effect on the expected project completion time which will have 95% confidence?</td><td>K6</td><td>CO5</td></tr>
</table>

Z-Z-Z END