24MCU630

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2026
(Sixth Semester)

Branch – **MATHEMATICS WITH COMPUTER APPLICATIONS**

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	Decision variable in an O.R. model are (i) controllable (ii) uncontrollable (iii) parameters (iv) constants	K1	CO1
	2	A constraint in an LPP restricts (i) Value of objective function (ii) value of the decision variable (iii) use of available resource (iv) uncertainty of optimum value	K2	CO1
2	3	The solution to a transportation problem with m-sources and n-destinations is feasible if the number of allocations are (i) m+n-1 (ii) m+n+1 (iii) m+n (iv) mxn	K1	CO2
	4	The method used for solving an assignment problem is called (i) MODI Method (ii) reduced matrix method (iii) Hungarian method (iv) none of the above	K2	CO2
3	5	A game is said to be fair, if (i) upper value is more than lower value of the game (ii) upper and lower values of the game are not equal (iii) upper and lower values of the game are not same and zero (iv) none of the above	K1	CO3
	6	A mixed strategy game can be solved by (i) matrix method (ii) algebraic method (iii) graphical method (iv) all of the above	K2	CO3
4	7	Network problems have advantage in terms of project (i) scheduling (ii) planning (iii) controlling (iv) all of the above	K1	CO4
	8	A dummy activity is used in network diagram, when (i) two parallel activites have the same tail and head events (ii) the chain of activities may have a common event, yet be independent by themselves (iii) both (a) and (b) (iv) none of the above	K2	CO4
5	9	Queue can form only when (i) arrivals exceed service capacity (ii) arrivals equals service capacity (iii) service facitlity is capable to serve all the arrivals at a time (iv) There are more then one service facilities	K1	CO5
	10	Multiple servers may be (i) in parallel (ii) in series (iii) in combination of parallel and series (iv) all of the above	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.	Consider the following problem faced by a production planner in a soft drink plant. He has two bottling machines A and B. A is designed for 8-ounce bottles and B for 16-ounce bottles. However, each can be used on both types with some loss of efficiency. The following data Available: Machine | 8-ounce bottles | 16-ounce bottles A | 100/minute | 40/minute B | 60/minute | 75/minute Each machine can be run 8-hours per day, 5 days per week. Profit on a 8-ounce bottle is 25 paise and on a 16-ounce bottle is 35 paise. Weekly production of the drink cannot exceed 3,00,000 ounces and the market can absorb 25,000 8-ounce bottles and 7,000 16-ounce bottles per week. The planner wishes to maximize his profit subject ,to all the production and marketing restrictions. Formulate this as a linear programming problem.	K2	CO1
		(OR)		

Cont...

1	11.b.	Use graphical method to solve the following LPP *minimize* $z = -x_1 + 2x_2$ Subject to the constraints: $-x_1 + 3x_2 \leq 10$ $x_1 + x_2 \leq 6$ $x_1 - x_2 \leq 2$ $x_1 \geq 0, x_2 \geq 0$	K2	CO1
2	12.a.	Use Least cost method and obtain initial basic feasible solution of the transportation problem	K2	CO2

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

(OR)

	12.b.	A departmental head has four subordinates, and four tasks tobe 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	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

How should be the tasks be allocated, one to a man, so as to minimize the total man-hours?

3	13.a.	Solve the game whose payoff matrix is given by			K2	CO3

	B	C	D
E	1	3	1
F	0	-4	-3
G	1	5	-1

(OR)

	13.b.	For the game with the following payoff matrix, determine the optimum stragies and the value of the game :				

	P_2	
P_1	5	1
	3	4

4	14.a.	Draw a network diagram for the following data:			K2	CO4

Activity	A	B	C	D	E	F	G	H	I	J
Preceding activities	None	A	A	B	A	B,E	C	D,F	G	H,I

(OR)

	14.b.	Draw a network diagram and identify the critical path				

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
duration	2	8	10	6	3	3	7	5	2	8

5	15.a.	A T.V repairmen 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 set is approximately poisson with an average rate of 10 per 8-hour day, what is repairmen's expected idle time each day?how many jobs are ahead of the average set just brought in?	K2	CO5

(OR)

	15.b.	On an average 96 patients per 24-hour day require the service of an emergency clinic. Also on an average, a patient requires 10 minutes of active attention.Assume that the facilty can handle only one emergency at a time. Suppose that it costs the clinic Rs.100 per patint treated to obtain an average servicing time of 10 minutes, 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.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

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

<table>
<tr><th>Module No.</th><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td>1</td><td>16</td><td>Use simplex method to solve
$maximize\ z = -107x_1 + x_2 + 2x_3$
Subject to the constraints:
$-14x_1 + x_2 - 6x_3 + 3x_4 = 7$
$16x_1 + x_2 - 6x_3 \leq 5$
$3x_1 - x_2 - x_3 \leq 0$
$x_1, x_2, x_3, x_4 \geq 0$</td><td>K3</td><td>CO1</td></tr>
<tr><td>2</td><td>17</td><td>Find the optimum solution for the following transportation problem.
<table>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>Supply</td></tr>
<tr><td>1</td><td>3</td><td>7</td><td>6</td><td>4</td><td>5</td></tr>
<tr><td>2</td><td>2</td><td>4</td><td>3</td><td>2</td><td>2</td></tr>
<tr><td>3</td><td>4</td><td>3</td><td>8</td><td>5</td><td>3</td></tr>
<tr><td>Demand</td><td>3</td><td>3</td><td>2</td><td>2</td><td></td></tr>
</table></td><td>K3</td><td>CO2</td></tr>
<tr><td>3</td><td>18</td><td>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:
<table>
<tr><td rowspan="2">Player A</td><td colspan="4">Player B</td></tr>
<tr><td></td><td>C</td><td>D</td><td>F</td><td>G</td></tr>
<tr><td></td><td>A</td><td>2</td><td>1</td><td>0</td><td>-2</td></tr>
<tr><td></td><td>B</td><td>1</td><td>0</td><td>3</td><td>2</td></tr>
</table></td><td>K3</td><td>CO3</td></tr>
<tr><td>4</td><td>19</td><td>A project consists of eight activites with the following relevant information:
<table>
<tr><td rowspan="2">Activity</td><td rowspan="2">Immediate Predecessor</td><td colspan="3">Estimated duration</td></tr>
<tr><td>Optimistic</td><td>Most likely</td><td>Pessimistic</td></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 wil 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?
(For standard normal Z=1.645 , area under the standard normal curve from o to Z is 0.45).</td><td>K3</td><td>CO4</td></tr>
<tr><td>5</td><td>20</td><td>A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can service 12 customers on an average per hour. After stating your assumptions, answer the following :
(i) what is the average number of customers waiting for the service of the clerk?
(ii) what is the average time a customer has to wait before getting service?
The management is contemplating to install a computer system to handle the information and reservations. This is expected to reduce the service time from 5 to 3 minutes. The additional cost of having the new system works out to Rs.50 per day. If the cost of goodwill of having to wait is estimated to be 12 paise per minute spent waiting before being served. Should the company install the computer system? Assume 8 hours working day.</td><td>K3</td><td>CO5</td></tr>
</table>

Z-Z-Z END