PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MCA DEGREE EXAMINATION MAY 2026
(Second Semester)

Branch – **COMPUTER APPLICATIONS**

MATHEMATICAL OPTIMIZATION

Time: Three Hours Maximum: 75 Marks

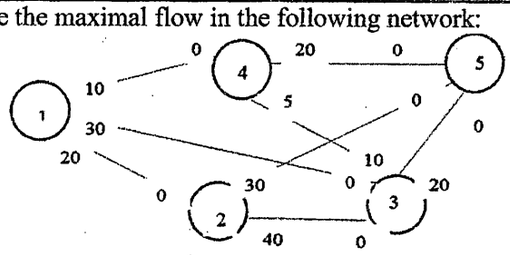
SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	If the value of the objective function **z** can be increased or decreased indefinitely, such solution is called a. bounded b. unbounded c. degenerate d. infeasible	K1	CO2
	2	The variable that is required to convert $x_1+2x_2+x_3 \geq 5$ to an equation is a. slack variable b. surplus variable c. basic variable d. non-basic variable	K2	CO2
2	3	The number of basic variables in a transportation problem with m origins and n destinations is a. m +n+1 b. m + n c. m-n-1 d. m+n-1	K1	CO2
	4	If there were 4 workers and 4 jobs in an assignment problem, there would be a. 24 solutions b. 12 solutions c. 48 solutions d. 21 solutions	K2	CO2
3	5	Which of the following is used for computation in CPM? *a. normal time* *b. most likely time* *c. pessimistic time* *d. optimistic time*	K1	CO3
	6	A PERT network has 9 activities on its critical path. The standard deviation of each activity on the critical path is 3. The standard deviation of the critical path is *a. 9* *b. 3* *c.27* *d.81*	K2	CO3
4	7	A situation in which a decision maker knows all of the possible outcomes of a decision and also knows the probability associated with each outcome is referred to as a. certainty b. uncertainty c. risk d. strategy	K1	CO4
	8	If Decision theory problem has 3 decision alternatives and 4 states of nature, then the number of payoffs in that problem will be *a.3* *b.4* *c.12* *d.64*	K2	CO4
5	9	Little's Formula is denoted by a. $\lambda = \frac{L}{\omega}$ b. L = λ/μ c. $L = \lambda + \omega$ d. L = p / μ	K1	CO4
	10	In $M/M/1$ model, the waiting time in the Queue (W_s)is a. $\frac{1}{(\mu-\lambda)}$ b. $\frac{2\lambda}{\mu(\mu-\lambda)^2}$ c. $\frac{1}{\mu(1-\rho)}$ d. $\frac{2}{(\mu-\lambda)^2}$	K2	CO4

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.	Solve the following LPP by Graphical method $maxmize\ z = x_1 + x_2$ Subject to $x_1 + x_2 \geq 800$ $x_1 + 2x_2 \leq 2000$ $x_1 + x_2 \leq 1500$ $x_2 \leq 600$ $x_1, x_2 \geq 0$	K2	CO2
		(OR)		

Cont...

<table>
<tr><td>1</td><td>11.b.</td><td>Ozark Farms at least 800 lb of special feed daily. The special feed is a mixture of corn and soybean meal with the following compositions:
<table>
<tr><td colspan="4">Lb per lb of feedstuff</td></tr>
<tr><td>Feedstuff</td><td>Protein</td><td>Fiber</td><td>Cost($/lb)</td></tr>
<tr><td>Corn</td><td>0.09</td><td>0.02</td><td>0.30</td></tr>
<tr><td>Soybean meal</td><td>0.60</td><td>0.06</td><td>0.90</td></tr>
</table>
The dietary requirements of the special feed are at least 30% protein and at most 5% fiber. Formulate this problem as a linear programming problem to minimise the cost of feed mix</td><td>K2</td><td>CO2</td></tr>
<tr><td rowspan="3">2</td><td>12.a.</td><td>Obtain the initial allocation in the following transportation table by using
(i) northwest-corner method
(ii) least cost method
<table>
<tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>Capacity</td></tr>
<tr><td>1</td><td>10</td><td>2</td><td>20</td><td>11</td><td>15</td></tr>
<tr><td>2</td><td>12</td><td>7</td><td>9</td><td>20</td><td>25</td></tr>
<tr><td>3</td><td>4</td><td>14</td><td>16</td><td>18</td><td>10</td></tr>
<tr><td>Demand</td><td>5</td><td>15</td><td>15</td><td>15</td><td></td></tr>
</table></td><td rowspan="3">K3</td><td rowspan="3">CO3</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>12.b.</td><td>For the given transportation problem obtain the initial basic feasible solution by VAM
<table>
<tr><td></td><td>I</td><td>II</td><td>III</td><td>IV</td><td>V</td><td>VI</td><td>Availability</td></tr>
<tr><td>1</td><td>9</td><td>12</td><td>9</td><td>6</td><td>9</td><td>10</td><td>5</td></tr>
<tr><td>2</td><td>7</td><td>3</td><td>7</td><td>7</td><td>5</td><td>5</td><td>6</td></tr>
<tr><td>3</td><td>6</td><td>5</td><td>9</td><td>11</td><td>3</td><td>11</td><td>2</td></tr>
<tr><td>4</td><td>6</td><td>8</td><td>11</td><td>2</td><td>2</td><td>10</td><td>9</td></tr>
<tr><td>Demand</td><td>4</td><td>4</td><td>6</td><td>2</td><td>2</td><td>10</td><td></td></tr>
</table></td></tr>
<tr><td rowspan="3">3</td><td>13.a.</td><td>Determine the maximal flow in the following network:

</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>Compare PERT and CPM. In what types of projects would PERT be more useful that CPM?</td></tr>
<tr><td rowspan="3">4</td><td>14.a.</td><td>Suppose that you want to invest $10000 in the stock market by buying shares in one of two companies: A and B. Shares in Company A, though risky could yield a 50%return during the neat year. If the stock market conditions are not favorable, the stock may lose 20% of its value. Company B provides safe investments with a 15% return in a “bull” market and only 5% market. All the publications you have consulted are predicting a 60% chance for a “bull” market and 40% chance for a “bear” market. How should you invest your money?</td><td rowspan="3">K4</td><td rowspan="3">CO4</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>14.b.</td><td>Two players, A and B, play the coin-tossing game. Each player, unbeknownst to the other, chooses a head(H) or tail(T). Both players would reveal their choices simultaneously. If they match (HH or TT), player A receives $1 from B. Otherwise , A pays B $1. Determine the winning player and assess the consistency of the decision.</td></tr>
<tr><td rowspan="3">5</td><td>15.a.</td><td>A service machine always has a standby unit for immediate replacement upon failure. The time to failure of the machine (or its standby unit) is exponential and occurs every 5 hours, on the average. The machine operator claims that the machine is “in the habit” of breaking down every night around .30pm. Analyze the operator’s claim.</td><td rowspan="3">K4</td><td rowspan="3">CO4</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>15.b.</td><td>Assess the queueing model (M/M/1):(GD/∞/∞)</td></tr>
</table>

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>Solve the following LPP by simplex method
$maximize\ z = 5x_1 + 4x_2$
Subject to $6x_1 + 4x_2 \leq 24$
$x_1 + 2x_2 \leq 6$
$-x_1 + x_2 \leq 1$
$x_2 \leq 2 \quad x_1, x_2 \geq 0$</td><td>K4</td><td>CO2</td></tr>
<tr><td>2</td><td>17</td><td>Joe Klyne's four children, John, Karen, Terri and Tom want to earn some money for personal expenses. Mr. Klyne has chosen four chores for his children: moving the lawn, painting the garbage door, washing and cleaning the family cars. To avoid anticipated sibling competitions, he asks them to submit individual (secret) bids for what they feel is fair pay for each of the four chores. The following table summarizes the bids received. The children will abide by their father's decision regarding the assignment of chores, bids received. Solve this problem by Hungarian method.
<table>
<tr><td></td><td>Mow</td><td>Paint</td><td>Wash</td><td>Clean</td></tr>
<tr><td>John</td><td>1</td><td>4</td><td>6</td><td>3</td></tr>
<tr><td>Karen</td><td>9</td><td>7</td><td>10</td><td>9</td></tr>
<tr><td>Terri</td><td>4</td><td>5</td><td>11</td><td>7</td></tr>
<tr><td>Tom</td><td>8</td><td>7</td><td>8</td><td>5</td></tr>
</table></td><td>K4</td><td>CO3</td></tr>
<tr><td>3</td><td>18</td><td>Determine the critical path for the project for following project
<table>
<tr><td>Activity</td><td>Time in Days</td></tr>
<tr><td>A: 1-2</td><td>5</td></tr>
<tr><td>B: 1-3</td><td>6</td></tr>
<tr><td>C: 2-3</td><td>3</td></tr>
<tr><td>D: 2-4</td><td>8</td></tr>
<tr><td>E: 3-5</td><td>2</td></tr>
<tr><td>F: 3-6</td><td>11</td></tr>
<tr><td>G: 4-6</td><td>1</td></tr>
<tr><td>H: 5-6</td><td>12</td></tr>
</table></td><td>K4</td><td>CO3</td></tr>
<tr><td>4</td><td>19</td><td>Solve the following game by linear programming. The value of the game lies between -2 and 2.
<table>
<tr><td></td><td>B1</td><td>B2</td><td>B3</td></tr>
<tr><td>A1</td><td>3</td><td>-1</td><td>-3</td></tr>
<tr><td>A2</td><td>-2</td><td>4</td><td>-1</td></tr>
<tr><td>A3</td><td>-5</td><td>-6</td><td>2</td></tr>
</table></td><td>K4</td><td>CO4</td></tr>
<tr><td>5</td><td>20</td><td>Visitor's parking at Ozark College is limited to five spaces only. Cars making use of this space arrive according to a Poisson distribution at the rate of six cars per hour. Parking time is exponentially distributed with a mean of 30 minutes. Visitors who cannot find an empty space on arrival may temporarily wait inside the lot until a parked car leaves. That temporary space can hold only three cars. Other cars that cannot park or find a temporary waiting space must go elsewhere. Determine the following:
(a) The probability of n cars in the system
(b) The effective arrival rate for cars that actually use the lot
(c) The average number of cars in the lot
(d) The average time a car waits for a parking space inside the lot</td><td>K4</td><td>CO4</td></tr>
</table>

Z-Z-Z END