22CAP213

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MCA DEGREE EXAMINATION MAY 2023
(Second Semester)

Branch – **COMPUTER APPLICATION**

MATHEMATICAL OPTIMIZATION

Time: Three Hours Maximum: 50 Marks

SECTION-A (5 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (5 x 1 = 5)

1. In degenerate solution value of objective function is _____
(i) One or more basic variables are zero (ii) basic variables are nonzero
(iii) decreases infinitely (iv) increases infinitely

2. The solution to a transportation problem with 'm' rows (supplies) & 'n' columns (destination) is basic feasible if number of positive allocations are _____
(i) m + n (ii) m * n (iii) m + n - 1 (iv) m + n + 1

3. PERT analysis is based on _____
(i) Optimistic time (ii) Pessimistic time
(iii) most likely time (iv) All the above

4. Zero sum game has to be a _____ game.
(i) single player (ii) two player
(iii) multi player (iv) three player

5. The inter departure time, corresponding to truncated Poisson distribution in a pure death model is ____ distributed.
(i) normal (ii) exponential
(iii) binomial (iv) poisson

SECTION - B (15 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 x 3 = 15)

6. a) An investor is considering investing in two securities 'A' and 'B'. The risk and return associated with these securities is different. Security 'A' gives a return of 9% and has a risk factor of 5 on a scale of zero to 10. Security 'B' gives return of 15% but has risk factor of 8. Total amount to be invested is Rs. 5, 00, 000/- Total minimum returns on the investment should be 12%. Maximum combined risk should not be more than 6. Formulate as LPP.

OR

b) Solve the following LPP by graphical method Minimize
$z = 5x_1 + 4x_2$ subject to constraints $4x_1 + x_2 \geq 40$; $2x_1 + 3x_2 \geq 90$ and $x_1, x_2 > 0$

7. a) Determine an Initial BFS to the following Transportation problem using VAM method.

Origin	Destination				Supply
	1	2	3	4	
1	20	22	17	4	120
2	24	37	9	7	70
3	32	37	20	15	50
Demand	60	40	30	110	240

OR

Cont...

7. b) Solve the following assignment problem.

		Men			
		A	B	C	D
Task	1	7	5	8	4
	2	5	6	7	4
	3	8	7	9	8

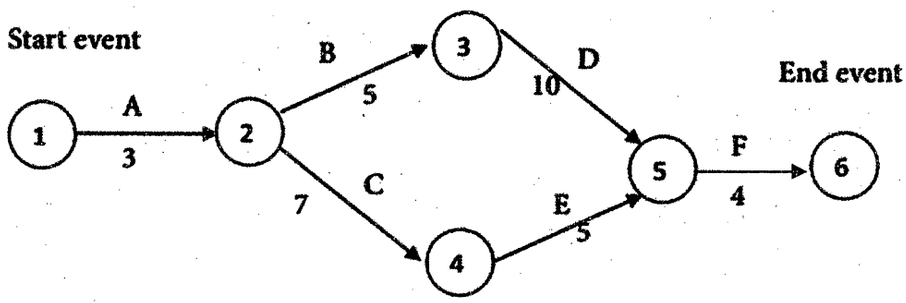
8. a) Determine the optimum project duration and cost for the following data.

	Normal		Crash	
Activity	Time (days)	Cost (Rs)	Time (days)	Cost (Rs)
1-2	8	100	6	200
1-3	4	150	2	350
2-4	2	50	1	90
2-5	10	100	5	400
3-4	5	100	1	200
4-5	3	80	1	100

Indirect cost is Rs.70 per day.

OR

b) Determine the critical path, the critical activities and the project completion time using CPM network method.



9. a) Solve the following pay-off matrix. Also determine the optimal strategies and value of the game.

$$\begin{array}{c} \\ A \\ \end{array} \begin{array}{c} B \\ \begin{bmatrix} 5 & 1 \\ 3 & 4 \end{bmatrix} \end{array}$$

OR

b) For What value of λ, the game with following payoff matrix is strictly determinable?

		Player B		
		B_1	B_2	B_3
Player A	A_1	λ	6	2
	A_2	-1	λ	-7
	A_3	-2	4	λ

10. a) Explain Kendall's notation for representing Queueing models and also about the classification of Queueing models.

OR

b) A super market has a single cashier. During the peak hours, customers arrive at a rate of 20 customers per hour. The average no of customers that can be processed by the cashier is 24 per hour. Find
(i) The probability that the cashier is idle.
(ii) The average no of customers in the queue system
(iii)The average time a customer spends in the system.
(iv)The average time a customer spends in queue.
(v) The any time a customer spends in the queue waiting for service.

SECTION - C (30 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 x 6 = 30)

11 a) Use Simplex method to solve Min $Z = -6x_1 - 10x_2 - 4x_3$ subject to $x_1 + x_2 + x_3 \leq 1000$, $x_1 + x_2 \leq 500$, $x_1 + 2x_2 \leq 700$, $x_1, x_2, x_3 \geq 0$.

OR

b) Use Big 'M' method to Maximize $z = 3x_1 + 2x_2$ subject to the constraints $2x_1 + x_2 \leq 2$, $3x_1 + 4x_2 \geq 12$, $x_1, x_2 \geq 0$.

12 a) Obtain optimal solution using MODI method

Plant	Distribution Centre				Supply
	D1	D2	D3	D4	
S1	19	30	50	12	7
S2	70	30	40	60	10
S3	40	10	60	20	18
Requirement	5	8	7	15	

OR

b) Given the matrix of set-up costs, show how to sequence the production so as to minimize the set-up cost per cycle.

∞	4	7	3	4
4	∞	6	3	4
7	6	∞	7	5
3	3	7	∞	7
4	4	5	7	∞

13 a) The following table shows the job of a network along with their time estimates.

Job	1-2	1-6	2-3	2-4	3-5	4-5	6-7	5-8	7-8
a (days)	1	2	2	2	7	5	5	3	8
m (days)	7	5	14	5	10	5	8	3	17
b (days)	13	14	26	8	19	17	29	9	32

Draw the project network and assess the probability of the project completing in 40 days.

OR

b) Draw the network diagram and determine the critical path for the following project:

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-7	5-8	6-8	7-9	8-9
Time estimate (Weeks)	5	6	3	5	7	10	4	2	5	6	4

14. a) Reduce the following game by Dominance and find the game value.

	I	II	III	IV
I	3	2	4	0
II	3	4	2	4
III	4	2	4	0
IV	0	4	0	8

OR

b) Solve the following 2 X 5 game graphically.

	I	II	III	IV	V
I	-5	5	0	-1	8
II	8	-4	-1	6	-5

15 a) Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean three minutes. Analyze the following.

(i) What is the probability that a person arriving at the booth will have to wait?

(ii) What is the average length of the queue that forms from time to time?

(iii) The telephone department will install a second booth when convinced that an arrival would have to wait at least three minutes for the phone. By how much time must the flow of arrivals be increased in order to justify a second booth?

OR

b) Customers arrive at a one-window drive-in bank according to Poisson distribution with mean 10 per hour. Service time per customer is exponential with mean five minutes. The space in front of the window including that for the serviced car can accommodate a maximum of three cars. Others can wait outside this space.

(i) What is the probability that an arriving customer can drive directly to the space in front of the window?

(ii) What is the probability that an arriving customer will have to wait outside the indicated space?

(iii) How long is an arriving customer expected to wait before starting service?

Z-Z-Z END