

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc(SS) DEGREE EXAMINATION MAY 2024
(Fourth Semester)

Branch – SOFTWARE SYSTEMS (five year integrated)

OPTIMIZATION TECHNIQUES

Time: Three Hours

Maximum: 50 Marks

SECTION-A (5 Marks)

Answer ALL questions

ALL questions carry EQUAL marks (5 x 1 = 5)

1. A constraint in a Linear programming problem is expressed as _____.
(i) an equation with = sign (ii) inequality with \geq sign
(iii) inequality with \leq sign (iv) any of the above
2. The minimum number of lines covering all zeros in a reduced cost matrix of order n can be
(i) at the most n (ii) at the least n
(iii) $n - 1$ (iv) $n + 1$
3. When maximin and minimax values of the game are same, then _____.
(i) there is a saddle point (ii) solution does not exist
(iii) strategies are mixed (iv) none of the above
4. When there are more than one servers, customer behavior in which he moves from one queue to another is known as _____.
(i) balking (ii) jockeying
(iii) reneging (iv) alternating
5. The slack for an activity in network is equal to _____.
(i) LS-ES (ii) LF-LS
(iii) EF-ES (iv) EF-LS

SECTION - B (15 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks (5 x 3 = 15)

6. a) State some significant features of Operations Research.
(OR)
b) Old hens can be bought for Rs.2.00 each and young ones cost Rs.5.00 each. The old hens lay 3 eggs per week and the young ones 5 eggs per week, each being worth 30 paise. A hen costs Rs.1.00 to feed. If I have only Rs.80.00 to spend for hens, how many of each kind should I buy to give a profit of more than 6.00 per week, assuming that I cannot house more than 20 hens? Write a mathematical model of the problem.
7. a) Obtain an initial basic feasible solution to the following transportation problem by north-west corner rule.

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

(OR)

- b) A departmental head has 4 subordinates and 4 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. How should the tasks be allocated, one to a man so as to minimize the total man-hours?

Tasks	Men			
	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	18	19	18	15
D	19	26	24	10

Cont...

8. a) Determine the range of values of p and q that will make the pay-off element a_{22} , a saddle point for the game whose pay-off matrix (a_{ij}) is given below:

$$A \begin{matrix} & \text{B} \\ \begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{matrix}$$

(OR)

- b) Consider a modified form of matching biased coins game problem. The matching player is paid Rs.8.00 if the two coins turn both heads and Re.1.00 if the coins turn both tails. The non-matching player is paid Rs.3.00 when the 2 coins do not match. Give the choice of being the matching or non-matching player. Which one would you choose and what would be your strategy?
9. a) A TV repairman finds that the time spent on his jobs has an Exponential distribution mean 30 minutes. If he repairs sets in the order in which they come in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8-hour day, what is the repairman's expected idle time each day? How many jobs are ahead of the average set just brought-in?

(OR)

- b) In a railway marshalling yard, goods train 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, and
(ii) the probability that the queue size exceeds 10.
If the input of the train increases to an average 33 per day, what will be the change in (i) and (ii)?

10. a) Construct a network diagram for the following data:

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)

- b) State the rules of constructing the network.

SECTION -C (30 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 x 6 = 30)

11. a) Consider the following linear programming problem:
Maximize $z = 2x_1 + 4x_2$, subject to the constraints
 $x_1 + 2x_2 \leq 5$; $x_1 + x_2 \leq 4$; $x_1 \geq 0$; $x_2 \geq 0$.
Demonstrate whether it is possible to get a unique solution to the above linear programming problem graphically.

(OR)

- b) Use simplex method to maximize $z = 4x_1 + 10x_2$ subject to the constraints
 $2x_1 + x_2 \leq 50$; $2x_1 + 5x_2 \leq 100$; $2x_1 + 3x_2 \leq 90$; $x_1 \geq 0$; $x_2 \geq 0$.

Cont...

12. a) Determine the initial basic feasible solution to the following transportation problem using Vogel's Approximation method, given the cost matrix:

	D1	D2	D3	D4	SUPPLY
S1	20	25	28	31	200
S2	32	28	32	41	180
S3	18	35	24	32	110
DEMAND	150	40	180	170	

(OR)

- b) A machine operator processes five types of items on his machine each week, and must choose a sequence for them. The set-up cost per change depends on the item presently on the machine and the set-up to be made according to the following table:

From item	To item				
	A	B	C	D	E
A	∞	4	7	3	4
B	4	∞	6	3	4
C	7	6	∞	7	5
D	3	3	7	∞	7
E	4	4	5	7	∞

Determine the optimum solution.

13. a) Solve the game whose pay-off matrix is:

Player A	Player B			
	1	2	3	4
1	4	-2	3	-1
2	1	2	0	1
3	-2	1	-2	0

(OR)

- b) Two firms A and B have for years been selling a competitive product which forms a part of both firms' total sales. The marketing executive of firm A raised the question, "What should be the firm's strategies in terms of advertising the product in the market?" The market research team of firm A developed the following data for varying degrees of advertising:

- (i) No advertising, medium advertising and large advertising for both firms will result in equal shares
- (ii) Firm A with no advertising: 40% of the market with medium advertising by firm B and 25% of the market with large advertising by firm B.
- (iii) Firm A using medium advertising: 70% of the market with no advertising by firm B and 45% of the market with large advertising by firm B.
- (iv) Firm A using large advertising: 75% of the market with no advertising by firm B and 47.5% of the market with medium advertising by firm B.
- (A) Based upon the foregoing information, answer the marketing executive's questions.
- (B) What advertising policy should firm A pursue when consideration is given to the above factors: selling price Rs. 4 per unit; variable cost of product Rs. 2.50 per unit; annual volume of 30,000 units from firm A; cost of annual medium advertising Rs. 5,000 and cost of annual large advertising Rs. 15,000? What contributions to the other fixed costs is available to the firm?

14. a) 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 the depositors and withdrawers if each teller could handle both withdrawals and deposits?

(OR)

Q. No 14 Cont...

14. b) A car servicing station has 3 stalls where service can be offered simultaneously. The cars wait in such a way that when a stall becomes vacant, the car at the head of the line pulls up to it. The station can accommodate at most four cars waiting at one time. The arrival pattern is Poisson with a mean of one car per minute during the peak hour. The service time is exponential with mean 6 minutes. Find the average number of cars in the service station during peak hours, the average waiting time and the average number of cars per hour that cannot enter the station because of full capacity.

15. a) A project consists of a series of tasks labelled A, B, . . . H, I with the following relationship. Construct the network diagram having the following constraints:
 $A < D, E; B, D < F; C < G; B, G < H; F, G < I$
 Find also the minimum time of completion of the project, when the time (in days) of completion of each task is as following:

Task :	A	B	C	D	E	F	G	H	I
Time:	23	8	20	16	24	18	19	4	10

(OR)

- b) Distinguish between PERT and CPM.

Z-Z-Z END