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21ME753

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Operations Research

Time: 3 hrs.

Max. Marks: 100

Note : 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of Statistical table permitted.*

Module-1

1   a.   Discuss the various phases of OR.   **(06 Marks)**

    b.   A manufacturer produces 3 models A, B and C of a certain product using raw materials X and Y. The following tables gives the data :

Raw Materials	Requirement per unit			Availability
	A	B	C	
X	2	3	5	4000
Y	4	2	7	6000
Minimum demand	20	200	150	-
Profit / Unit	30	20	50	-

Formulate the above as LPP to maximize the profit.   **(14 Marks)**

OR

2   a.   Discuss the scope of Operation Research in management across different functional areas.   **(05 Marks)**

    b.   Find the maximum value of the following LPP model , using graphical method :
    $Z = 2x_1 + 3x_2$ of the following LPP model.
    Subject to $x_1 + x_2 \leq 30$
    $x_2 \geq 3$
    $x_2 \leq 12$
    $x_1 - x_2 \geq 0$
    $0 \leq x_1 \leq 20$.   **(15 Marks)**

Module-2

3   a.   Explain the following i) basic feasible solution   ii) degenerate basic feasible solution   iii)   unbounded solution.   **(06 Marks)**

    b.   Solve by simplex method the following L.P problem :
    Maximize $Z = 4x_1 + 3x_2 + 6x_3$
    Subject to $2x_1 + 3x_2 + 6x_3 \leq 440$
    $4x_1 + 3x_3 \leq 470$
    $2x_1 + 5x_2 \leq 430$
    $x_1 , x_2 , x_3 \geq 0$.   **(14 Marks)**

OR

4   a.   Describe the canonical and standard form of LPP with their characteristics.   **(06 Marks)**

    b.   Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B per gram and costs 20 paise per gram. The daily minimum requirements of vitamin A and vitamin B is 100 units and 200 units respectively. Find the minimum cost of product mix using Big M method.   **(14 Marks)**

Module-3

5   A company has 3 factories manufacturing the same product and 5 sales agencies in different parts of the Country. Product costs differ from factory to factory and the selling prices from agency to agency. The shipping cost per unit product from each factory to each agency is known. Given the following data :

i)   Formulate this problem as a transportation problem in order to maximize profit.
ii) Find the solution using VAM method.
iii) Test for optimality and find the optimal solution.

Factory i	Production cost/unit (Rs)	Maximum capacity (No. of units)
1	18	140
2	20	190
3	16	115

Factory i

	1	2	2	6	10	5
	2	10	8	9	4	7
	3	5	6	4	3	8

Shipping cost (Rs)

Agency j	1	2	3	4	5
Demand	74	94	69	39	119
Selling price , Rs	35	37	36	39	34

(20 Marks)

OR

6 a. Differentiate between balanced and unbalanced transportation problems with example for each. **(05 Marks)**

    b. Solve the following assignment problem :

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

(15 Marks)

Module-4

7 a. The utility data for a network diagram are given below. Determine the total , free, independent and interfering floats and also identify critical path. **(14 Marks)**

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

    b. For the following project draw the network and trace the critical path.

Activity	0-1	1-2	1-3	1-4	2-3	3-4	4-5
Duration	3	6	16	10	8	5	3

(06 Marks)

OR

8   a.   The time estimates (in weeks) for the activities of a PERT network are given below :

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
t_o	1	1	2	1	2	2	3
t_m	1	4	2	1	5	5	6
t_p	7	7	8	1	14	8	15

   i)   Draw the project network and identify all the paths through it.
   ii)   Determine the expected project length.
   iii) Calculate the standard deviation and variance of the project length.
   iv)   What is the probability that the project will be completed at least 4 weeks earlier than expected time?
   v)   Find the probability that the project will be completed on schedule if the scheduled completion time is 20 weeks.   **(10 Marks)**

   b.   A person repairing radios find that the time spent on the radio sets has exponential distribution with mean 20 minutes. If the radios are repaired in the order in which they come in and their arrival is approximately Poisson with an average rate of 15 for 8 – hour day, what is the repairman's expected idle time each day? How many job are ahead of the average set just brought in.   **(10 Marks)**

Module-5

9   a.   Define Game , Optimal strategy , Zero sum game and Strategy.   **(06 Marks)**
   b.   Solve the given game by Graphical method as shown below :

	y_1	y_2	y_3	y_4
x_1	19	6	7	5
x_2	7	3	14	6
x_3	12	8	18	4
x_4	8	7	13	-1

                                                                                      (14 Marks)

OR

10   a.   Use graphical method to minimize the time required to process the following jobs on the machines. For each machine specify the job which should be done first. Also calculate the total elapsed time to complete both jobs.   **(10 Marks)**

Job 1	Sequence :	A	B	C	D	E
	Time (hr) :	6	8	4	12	4
Job 2	Sequence :	B	C	A	D	E
	Time (hr) :	10	8	6	4	12

b. A refrigeration company has six plants located in different parts of a city. Every year it is necessary for each plant to be completely overhauled. The overhauling is carried out in two stages A and B and each stage requires a crew of workmen with completely different skills. The work on stage B can start only when stage A has been completed. The plant has to be closed for the entire period of the overhauling. The company at present is following the schedule of the overhaul of the six plants as given below :

Time required by the crew (days)

Plant	P_1	P_2	P_3	P_4	P_5	P_6
Crew A	12	9	10	8	10	10
Crew B	10	7	9	14	6	8

i) Determine the optimal sequence.

ii) If downtime of any of the six plant costs Rs 5,000 per day , idle time for crew A costs Rs 1500 per day and idle time for crew B costs Rs 2500 per day, which of the two schedules, the present one or the one determined in part (i) will be more economical? What are their respective costs? **(10 Marks)**

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