UNIVERSITY OF KERALA
Model Question Paper
First Degree Programme
Semester V Open Course
MM 1551.1 Operations Research

Time: 3 hours **Maximum Marks: 80**

Section-I

All the first 10 questions are compulsory. They carry 1 mark each.

1. In the LPP: Maximize $Z = x_1 + x_2$; subject to $2x_1 - 3x_2 \leq 10,\ x_1 + 2x_2 \geq 5;\ x_1, x_2 \geq 0$, convert the constraints into equalities.
2. Convert the RHS of the inequality constraint $x_1 - 3x_2 + 5x_3 - 2x_4 \geq -15$ to positive.
3. State any one advantage of simplex method of solving an LPP over graphical method.
4. If there are four decision variables in an LPP, which method will you use to find an optimal solution?
5. Name any one method to find a solution for a Transportation Problem
6. What happens to a basic feasible solution of a transportation problem if one or more basic variables assume a zero value?
7. Write a necessary and sufficient condition for the existence of a feasible solution to the general transportation problem.
8. What should be the number of allocations for the solution to a transportation problem with m-sources and n-destinations to be feasible?
9. Name the mathematician who developed the Hungarian method for solving an Assignment problem?
10. What is PERT?

Section-II

Answer any 8 questions from among the questions 11 to 22.
These questions carry 2 marks each.

11. Use graphical method to:
    Maximize: $Z = 5x_1 + x_2$; subject to $x_1 + x_2 \leq 10,\ 2x_1 + 3x_2 \geq 10;\ x_1, x_2 \geq 0$
12. Write in standard form: Maximize $Z = 2x_1 + x_2 + 7x_3$
    Subject to $2x_1 - x_2 + 2x_3 \geq 4,\ \ 3x_1 - 2x_2 + 3x_3 \leq 6;\ \ x_1, x_2, x_3 \geq 0$
13. Represent the following LPP given in standard form in matrix-vector notation:

Maximize $Z = x_1 + 2x_2 - 3x_3 + 4x_4$

Subject to
$$\begin{aligned} 2x_1 + 2x_2 + x_3 + 5x_4 &= 7 \\ 3x_2 - 2x_3 + x_4 &= 2 \\ 4x_1 + 7x_2 + 3x_3 + x_4 &= 5 \\ x_1, x_2, x_3, x_4 &\geq 0 \end{aligned}$$

14. Write the linear program formulation of a transportation problem.
15. Write the steps involved in the North-West Corner Rule for finding an initial basic feasible solution to a transportation problem.
16. What is meant by an optimality test in a transportation problem?
17. How the problem of degeneracy arises in a transportation problem? Explain how does one overcome it?
18. What is an assignment problem? How does it differ from a transportation problem?
19. Give the mathematical formulation of an assignment problem
20. Is it advisable to solve an assignment problem using transportation algorithm? Why?
21. How does the problem of degeneracy arise in a transportation problem?
22. Mention any one difference between CPM and PERT

Section-III

Answer any 6 questions from among the questions 23 to 31.
These questions carry 4 marks each.

23. The Handy-Dandy Company wishes to schedule the production of a kitchen appliance that requires two resources – labour and material. The company is considering three different models and its production engineering department has furnished the following data:

	Model		
	A	B	C
Labour (hours per unit)	7	3	6
Material (pounds per unit)	4	4	5
Profit ($ per unit)	4	2	3

The supply of raw material is restricted to 200 pounds per day. The daily availability of labour is 150 hours. Formulating this as a linear programming model to determine the daily production rate of the various models in order to maximize the total profit.

24. Use the graphical method to solve the following LP problem:

Minimize $Z = 40x_1 + 36x_2$

Subject to

$$\begin{aligned} 5x_1 + 3x_2 &\geq 45 \\ x_1 &\leq 8 \\ x_2 &\leq 10 \\ x_1, x_2 &\geq 0 \end{aligned}$$

25. Use Simplex method to solve:

Maximize $Z = 3x_1 + 2x_2$

Subject to

$$\begin{aligned} -x_1 + 2x_2 &\leq 4 \\ 3x_1 + 2x_2 &\leq 14 \\ x_1 - x_2 &\leq 3 \\ x_1, x_2 &\geq 0 \end{aligned}$$

26. Write the linear program formulation of a transportation problem.
27. Obtain an initial basic feasible solution to the following transportation problem using the North-West Corner Rule.

	D_1	D_2	D_3	D_4	Supplies
S_1	20	25	28	31	200
S_2	32	28	32	41	180
S_3	18	35	24	32	110
Demands	150	40	180	170	

28. Obtain the optimal assignment of four jobs and four machines when the cost of assignment is given by the following table:

	J_1	J_2	J_3	J_4
M_1	10	9	8	7
M_2	3	4	5	6
M_3	2	1	1	2
M_4	4	3	5	6

29. Use the Hungarian method to solve the following assignment problem:

	J_1	J_2	J_3	J_4
M_1	10	9	7	8
M_2	5	8	7	7
M_3	5	4	6	5
M_4	2	3	4	5

30. Draw the network of the project consisting of 5 jobs A, B, C, D and E with the following job sequence:

    Job A precedes C and D
    Job B precedes D
    Job C and D precede E

31. For an activity with optimistic time of completion 3 days, pessimistic time of completion 5 days and most probable time of completion 4 days, find its expected time of completion and variance of the job time.

Section-1V
Answer any 2 questions from among the questions 32 to 35.
These questions carry 15 marks each.

32. Solve the following linear program:

Maximize $Z = x_1 + 3x_2$
Subject to
$x_1 \leq 5$
$x_1 + 2x_2 \leq 10$
$x_2 \leq 4$
$x_1, x_2 \geq 0$

33. Obtain an initial basic feasible solution to the following transportation problem using the north-west corner rule.

	M_1	M_2	M_3	M_4	Warehouse Capacity
W_1	11	13	17	14	250
W_2	16	18	14	10	300
W_3	21	24	13	10	400
Market Demand	200	225	275	250	

34. A company has three production facilities S_1, S_2 and S_3 with production capacity of 7, 9 and 18 units (in 100s) per week of a product, respectively. These units are to be shipped to four warehouses D_1, D_2, D_3 and D_4 with requirement of 5, 8, 7 and 14 units (in 100s) per week, respectively. The transportation costs (in rupees) per unit between factories to warehouses are given below. Obtain an optimal solution.

	D_1	D_2	D_3	D_4	Capacity
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Demand	5	8	7	14	34

35. Draw the A project consists of seven activities for which the relevant data are given below:

Activity	**Preceding activities**	**Duration (days)**
A	---	4
B	---	7
C	---	6
D	A, B	5
E	A, B	7
F	C, D, E	6
G	C, D, E	5

i. Draw the network.

ii. Identify the critical path and find the project completion time.

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