

Reg. No. : .....

Name : .....

Fifth Semester B.A./B.Sc./B.Com. Degree Examination, February 2021

First Degree Programme Under CBCSS

Mathematics

Open Course

MM 1551.1 — OPERATIONS RESEARCH

(2018 Admission Regular)

Time : 3 Hours

Max. Marks : 80

SECTION – I

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

1. The linear function which is to be maximized or minimized is called \_\_\_\_\_.
2. The values of the decision variable in an LPP which satisfy the constraints are called \_\_\_\_\_ solution.
3. In an LPP a constraint of the type  $\leq$  can be converted into equation by introducing \_\_\_\_\_ variable to the left side of the constraints.
4. A set of all feasible solution of LPP is \_\_\_\_\_.
5. A feasible solution to the transportation problem is called a basic feasible solution if the number of allocation is equal to \_\_\_\_\_.
6. Vogels approximation method is also called \_\_\_\_\_.
7. Modified distribution method is also called \_\_\_\_\_ method.

8. The solution for the assignment problem is possible only when the matrix is a \_\_\_\_\_.
9. Critical path method (CPM) developed in the year \_\_\_\_\_
10. Optimistic time is the \_\_\_\_\_ timing PERT calculation.

**(10 × 1 = 10 Marks)**

### SECTION – II

Answer **any eight** questions from among the questions **11 to 26**. These questions carry **2 mark each**.

11. A person requires 10,12,14 units of chemical ABC respectively for his garden. A liquid product contains 5, 2 and 1 units of A, B and C respectively per jar. A dry product contains 1,2 and 4 units of A, B, C per carton. If the liquid product sells for Rs. 3 per jar and the dry product sells for Rs. 2 per carton how many of each should be purchased to minimize the cost and meet the requirements.
12. Define Slack variable.
13. Write the following LPP model in the standard form  
 Maximize  $Z = x_1 + x_2$  S.t  

$$-x_1 + 2x_2 \leq -3$$

$$4x_1 - 3x_2 \leq -6$$

$$x_1, x_2 \geq 0.$$
14. What is the Reformulated form of LPP.
15. Write the Algorithm of Assignment problem.
16. Is traveling salesman problem similar to assignment problem?
17. Define Big-M-method.
18. Define North West Corner Rule.

19. Solve the transportation problem and find the initial basic feasible solution.

	A	B	C	$a_i$
$F_1$	10	9	8	8
$F_2$	10	7	10	7
$F_3$	11	9	7	9
$F_4$	12	14	9	
$b_j$	10	10	8	

20. Solve the following assignment problem.

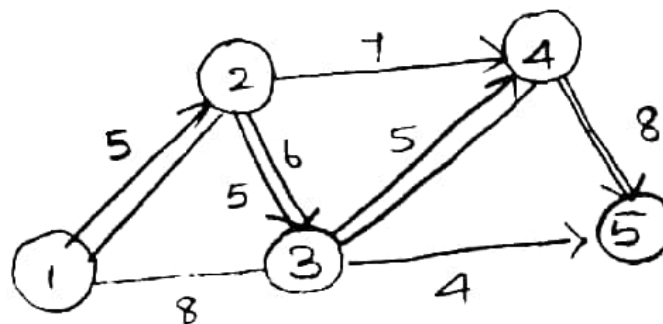
	1	2	3	4	5
A	20	15	25	25	29
B	13	19	30	13	19
C	20	17	14	12	15
D	14	20	20	16	24
E	14	16	19	11	22

21. What are the two Property's of assignment problem?

22. What are the two steps for solving a maximization problem.

23. Define critical path method. What are the two types of CPM.

24. Find the path and duration from the below figure.



25. Is any relation between optimistic time estimate and Pessimistic time estimate? Explain.

26. The following data are the characteristics of a project.

Activity	Immediate predecessors	Duration in days
A	–	2
B	A	3
C	A	4
D	B, C	6
E	–	2
F	E	8

Draw the network diagram.

**(8 × 2 = 16 Marks)**

### SECTION – III

Answer **any six** questions from among the questions **27 to 38**. These questions carry **4** marks.

27. An animal feed company must produce 200 kgs of a minimum consisting of ingredient  $X_1$  and  $X_2$  daily.  $X_1$  cost Rs. 3 per Kgs and  $X_2$  Rs. 8 per Kg. Not more than 80 kgs of  $X_1$  can be used and at least 60 kgs of  $X_2$  must be used. Find how much of each ingredient should be used if the company wants to minimize the cost.
28. Let us assume that you have inherited Rs.1,00,000 from your father-in-law that can be invested in a combination of only two stock portfolios with the maximum allowed in either portfolio set at Rs. 75,000. the first portfolio has an average rate of return of 10% Where as the second has 20%. In terms of risk of factors associated with these portfolios, the first has a risk rating of 4 and the seconds has 9. Since you wish to maximize your return, you will not accept an average rate of return below 12% or a risk factor above it. Hence you then face an important question. How much should you invest in each portfolio? Formulate this as a linear programming problem and solve by graphical method.
29. Solve the following LPP by simplex method

$$\text{Max } Z = 2x_1 + 5x_2$$

Subject to :

$$x_1 + 2x_2 \leq 8$$

$$x_1 \leq 4$$

$$0 \leq x_2 \leq 3, x_1 \text{ is unrestricted.}$$

30. Solve the following transportation problem :

	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
O <sub>1</sub>	1	2	3	4	6
O <sub>2</sub>	4	5	2	0	8
O <sub>3</sub>	0	2	2	1	10
	4	6	8	6	24

31. Explain graphical method and its types.

32. Using North west corner rule find an initial basic feasible solution for the following transportation problem :

	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	a <sub>i</sub>
F <sub>1</sub>	2	7	4	5
F <sub>2</sub>	3	3	1	8
F <sub>3</sub>	5	4	7	7
F <sub>4</sub>	1	6	2	14
b <sub>j</sub>	2	9	18	34
				29

33. Determine the optimum solution to the following T.P.

Waterhouse	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	Capacity
Factory				
F <sub>1</sub>	8	8	15	120
F <sub>2</sub>	15	10	17	180
F <sub>3</sub>	3	9	10	80
Requirement	150	80	50	280

34. Prove that the optimal solution to an assignment problem remains the same if a constant is added (or) subtracted to any row or column of the cost matrix.

35. Determine the optimum sequence for the following sequencing problem in which 5 jobs are done in 2 machines  $M_1$  and  $M_2$  in the order  $M_1, M_2$ . Processing times are given in hours in the following table.

	$M_1$	$M_2$
$J_1$	10	4
$J_2$	2	12
$J_3$	18	14
$J_4$	6	16
$J_5$	20	6

36. A project has the following characteristics

Activity	Duration	Predecessors
A	6	None
B	8	A
C	4	B
D	9	B
E	2	C
F	7	D

Construct and compute the network  $T_E$  and  $T_L$  for each and critical path and project duration.

37. Explain Simplex method.  
 38. Solve the following LPP using Simplex method

$$\text{Max } Z = 45x_1 + 80x_2$$

Subject to :

$$5x_1 + 20x_2 \leq 400$$

$$10x_1 + 15x_2 \leq 450$$

$$x_1, x_2 \geq 0.$$

**(6 × 4 = 24 Marks)**

SECTION – IV

Answer **any two** questions **each** question carry **15** marks.

39. Solve the following LPP graphically.

$$\text{Maximize } Z = 20x_1 + 30x_2$$

$$\text{Subject to } 3x_1 + 3x_2 \leq 36 \text{ — (1)}$$

$$5x_1 + 2x_2 \leq 50 \text{ — (2)}$$

$$2x_1 + 6x_2 \leq 60 \text{ — (3)}$$

$$x_1, x_2 \geq 0$$

40. Use simplex method to solve the LPP.

$$\text{Maximize } z = 30x_1 + 20x_2$$

$$\text{Subject to } 10x_1 + 8x_2 \leq 800$$

$$x_1 \leq 60$$

$$x_2 \leq 75$$

$$x_1, x_2 \geq 0$$

41. Use simplex method to solve the following LPP.

$$\text{Maximize } z = 2x_1 + x_2$$

$$\text{Subject to } x_1 + 2x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1 - 2x_2 \leq 1$$

$$x_1, x_2 \geq 0$$

42. Using North-West Corner Rule find the initial basic feasible solution for the transportation problem and then solve.

	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	a <sub>i</sub>
S <sub>1</sub>	3	1	7	4	300
S <sub>2</sub>	2	6	5	9	400
S <sub>3</sub>	8	3	3	2	500
b <sub>j</sub>	250	350	400	200	1200

43. A company has 4 machines on which to do 3 jobs. Each job can be assigned to one and only machine. The cost of each machine is given in the following table. What are the job assignments, which will minimize the cost?

	A	B	C	D
X	18	24	28	32
Y	8	13	17	19
Z	10	15	19	22

44. The following indicates the details of a project the duration are in days. A refers optimistic time  $m$  refers most likely time  $a$  and  $b$  refers Pessimistic time estimate.

Activity	1-2	1-3	1-4	2-4	2-5	3-4	4-5
$a$	2	3	4	8	6	2	2
$m$	4	4	5	9	8	3	5
$b$	5	6	6	11	12	4	7

- (a) Draw the network.  
 (b) Find the critical path.  
 (c) Determine the mean and SD of the project completion time.

**(2 × 15 = 30 Marks)**