



Answer **any one** essay questions out of 2.

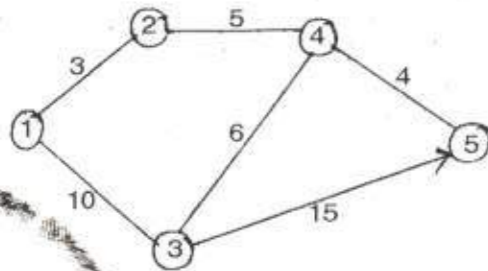
(1×10=10)

34. Using dual simplex method, solve the LPP :

Minimize  $z = 5x_1 + 3x_2 + 5x_3$  subject to

$2x_1 + x_2 + x_3 \geq 2$ ,  $x_1 + x_2 + 2x_3 \geq 3$ ,  $x_1, x_2, x_3 \geq 0$ .

35. Using Floyd's algorithm, find the shortest route between every two nodes of the following graph. Arc (3, 5) is directional, so that no traffic is allowed from node 5 to node 3.



Reg. No. : .....

Name : .....

**IV Semester B.Sc. Hon's (Mathematics) Degree (Regular/Supple./Improv.)**  
**Examination, May 2017**

**BHM 403 : OPERATIONS RESEARCH (2013 Admission)**

Time : 3 Hours

Max. Marks : 80

Answer **all** the **ten** questions.

(10×1=10)

1. What do you mean by surplus variables ?
2. What is the penalty rule for artificial variables ?
3. Explain the terms degeneracy and cycling in LPP.
4. What is the effect of dual constraints if the primal variables are unrestricted in sign ?
5. List any three cases that can arise in post-optimal analysis of an LPP and the action needed to obtain the new solution.
6. What do you mean by a balanced transportation problem ?
7. Define an Assignment problem.
8. What do you mean by transshipment node ?
9. Define a spanning tree.
10. What do you mean by Critical Path Method ?

Answer **any 10** short answer questions out of 14.

(10×3=30)

11. Express the following linear programming problem into standard form :  
 Maximize  $Z = 3x_1 + 2x_2 + 5x_3$  subject to  
 $2x_1 - 3x_2 \leq 3$ ,  $x_1 + 3x_2 + 3x_3 \leq 5$ ,  $3x_1 + 2x_3 \leq 2$ ,  $x_1 \geq 0$ ,  $x_2 \geq 0$ ,  $x_3 \geq 0$ .
12. Explain algebraic method to solve a LPP.



13. Show algebraically that all the basic solutions of the following LPP are infeasible :  
Maximize  $z = x_1 + 2x_2$  subject to  $x_1 + 2x_2 \leq 6, 2x_1 + x_2 \leq 16, x_1, x_2 \geq 0$ .
14. Compare M-method and two phase method for solving LPPs containing equations and  $\geq$  constraints.
15. Write the dual of the LPP :  
Minimize  $z = 15x_1 + 12x_2$  subject to  
 $x_1 + 2x_2 \geq 3, 2x_1 - 4x_2 \leq 5, x_1, x_2 \geq 0$ .
16. Write a note on advantages of using dual LPP instead of primal LPP.
17. Explain least-cost method to find the starting solution of a transportation problem.
18. Write the transportation algorithm.
19. Explain the difference between transportation problem and assignment problem.
20. Draw a network of five nodes, determine a path and a cycle in it.
21. Write Dijkstra's algorithm for shortest route problem.
22. Explain the linear programming formulation of maximal flow mode.
23. Explain forward pass critical path calculations.
24. Compare optimistic time estimate and pessimistic time estimate in PERT calculations.

Answer **any 6** short answer questions out of 9.

(6x5=30)

25. Using graphical method, solve the LPP :  
Maximize  $z = 2x_1 + 3x_2$  subject to  
 $x_1 + 3x_2 \leq 6, 3x_1 + 2x_2 \leq 6, x_1, x_2 \geq 0$ .
26. Briefly explain simplex method algorithm to solve an LPP.
27. By an example, show that dual of the dual is primal.
28. Briefly explain economic interpretation of duality.



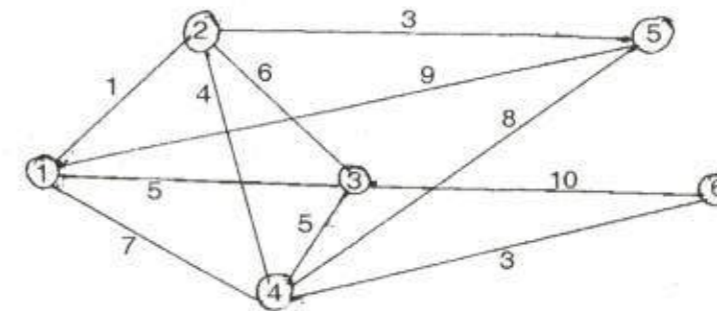
29. Using Vogel approximation method find a starting solution to the transportation problem :

	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	Demand
O <sub>1</sub>	8	4	6	6	34
O <sub>2</sub>	6	6	8	7	15
O <sub>3</sub>	9	7	7	6	12
O <sub>4</sub>	7	2	7	5	19
Supply	21	25	17	17	80

30. Explain the simplex explanation of the Hungarian method to solve an assignment problem.
31. Solve the assignment problem :

	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	M <sub>4</sub>
J <sub>1</sub>	6	12	7	15
J <sub>2</sub>	11	8	11	7
J <sub>3</sub>	16	14	15	12
J <sub>4</sub>	9	9	11	6

32. Solve the minimum-span problem for the network given below :



33. A project consists of nine jobs (A, B, C, . . . I) with the following precedence relation and time estimates. Draw the project network.

Job	A	B	C	D	E	F	G	H	I
Predecessor	-	-	A, B	A, B	B	D, F	C, F	D, E	G, H
Time (days)	15	10	10	10	5	5	20	10	15