K18U 1072

Reg. No. : .....

Name : .....

IV Semester B.Sc. Degree (CCSS – Supplementary) Examination, May 2018
(2012 & 13 Admissions)
Complementary Course in Mathematics for B.C.A.
4C04MAT (BCA) : OPERATIONS RESEARCH

Time : 3 Hours Max. Weightage : 30

Answer **all** questions. Weightage for a bunch of **four** questions is **1**.

1. Fill in the blanks :

   a) Any feasible solution which optimizes the objective function is called its _____

   b) The value of the decision variable of a dual of a LPP represents _____

   c) The iterative method for determining an optimum solution of a transportation problem is known as _____ method.

   d) The iterative method for solving an assignment problem is known as _____ method.

   e) An LPP in which some or all of the variables in the optimal solution are restricted to assume non-negative integer values is called _____

   f) The principle of optimality in dynamic programming is due to _____

   g) The total elapsed time in a sequencing problem can also be calculated by using _____ chart.

   h) The name of the probability distribution used in PERT which estimates the expected duration and the expected variance of the activity is _____

(Weightage 2×1=2)

Answer **any 6** questions. (Weightage **1 each**)

2. Write the general form of a LPP.

3. What is meant by feasible solution and optimal solution ?

P.T.O.

4. What are the general rules for obtaining a dual from a primal ?
5. What are the advantages of duality ?
6. When do you say a transportation problem is unbalanced ? How do you overcome this situation ?
7. Write the mathematical formulation of an assignment problem.
8. State Bellman's principle of optimality.
9. Write down the assumptions made while dealing with sequencing problems.
10. Distinguish between CPM and PERT. **(Weightage 6×1=6)**

Answer **any 7** questions. (Weightage **2 each**).

11. Use graphical method to solve the following LPP :
    Maximize $Z = 10x_1 + 6x_2$
    Subject to the constraints $5x_1 + 3x_2 \leq 30$; $x_1 + 2x_2 \leq 18$; $x_1 \geq 0$, $x_2 \geq 0$.
    What can you say about the number of solutions ?
12. A firm has available 240, 370 and 180 Kg of wood, plastic and steel respectively. The firm produces two products A and B. Each unit of A requires 1, 3 and 2 Kg of wood, plastic and steel respectively. The corresponding requirements for each unit of B are 3, 4 and 1 respectively. If A sells for Rs. 4 and B for Rs. 6, determine how many units of A and B should be produced in order to obtain the maximum gross income. Use the simplex method.
13. Solve the following LPP by Big-M method :
    Maximize $Z = -x_1 + 3x_2$
    Subject to the constraints $x_1 + 2x_2 \geq 2$, $3x_1 + x_2 \leq 3$, $x_1 \leq 4$.
14. Write down the dual of the following primal problem :
    Minimize $Z = 4x_1 + 6x_2 + 3x_3$
    Subject to the constraints $3x_1 + 4x_2 + x_3 \geq 10$, $-2x_1 - 3x_2 + 2x_3 \leq -5$,
    $x_1 - 2x_2 - 3x_3 \leq -1$, $3x_1 + 2x_2 + 2x_3 \geq 5$, $x_1 \geq 0$, $x_2 \geq 0$, $x_3 \geq 0$.
    Also find the dual of the dual. What is your observation ?

15. Find an initial basic feasible solution to the following transportation problem using Vogel's approximation method :

To

From	D_1	D_2	D_3	D_4	Availability
O_1	5	8	3	6	30
O_2	4	5	7	4	50
O_3	6	2	4	6	20
Requirement	30	40	20	10	100

Test this solution for optimality.

16. Solve the following mixed-integer programming problem :
Maximize $Z = x_1 + x_2$
Subject to the constraints $3x_1 + 2x_2 \leq 5$; $x_2 \leq 2$; $x_1 \geq 0$, $x_2 \geq 0$, x_1 an integer.

17. Explain the step by step procedure of Gomory's all integer programming algorithm.

18. Write down the general algorithm for solving a problem using dynamic programming approach.

19. Write the optimal sequence algorithm for processing n jobs through two machines.

20. A company has five jobs on hand, coded A to E. All the jobs have to go through two machines M_1 to M_2 in the order M_1 M_2. The time required for the jobs on each machine, in hours, is given below :

Job :	A	B	C	D	E
M_1 :	10	2	18	6	20
M_2 :	4	12	14	16	8

Draw the sequence table scheduling the five jobs on the two machines. Find the total time elapsed. Also calculate the idle times of the machines M_1 and M_2.

21. A project consists of nine jobs (A, B, . . ., I) with the following precedence relations and the time estimates :

Job :	A	B	C	D	E	F	G	H	I
Predecessor :	–	–	–	A	A	B, D	C	C	F,G
Time (days) :	8	10	8	10	16	17	18	14	9

i) Draw the network;
ii) Determine the earliest and latest starting and completion times of jobs; and
iii) Identify the critical path and the minimum time of completion of the project.

(Weightage 7×2=14)

Answer **any 2** questions. (Weightage **4 each**).

22. Solve the following LPP using the two-phase simplex method :
Minimize $Z = x_1 + x_2$
Subject to the constraints $2x_1 + 4x_2 \geq 4$; $x_1 + 7x_2 \geq 7$; $x_1 \geq 0$, $x_2 \geq 0$.

23. A government space project is conducting research on a certain engineering problem that must be solved before man can fly to Mars safety. Three research teams are currently trying three different approaches for solving this problem. The estimate has been made that, under present circumstances ,the probability that the respective teams (say A, B and C) will not succeed are 0.40, 0.60 and 0.80 respectively. Thus the current probability that all three teams will fail is 0.192. Since the objective is to minimize this probability, the decision has been made to assign two or more top scientists among the three teams in order to lower it as much as possible. The following table gives the estimated probability that the respective teams will fall when 0, 1 or 2 additional scientists are added to that team :

Number of new Scientists	Probability of failure of		
	Team A	Team B	Team C
0	0.40	0.60	0.80
1	0.20	0.40	0.50
2	0.15	0.20	0.30

Using deterministic dynamic programming, determine how should the additional scientists be allocated to the teams ?

24. A project consists of the following activities and time estimates :

Activity :	1 – 2	1 – 3	1 – 4	2 – 5	2 – 6	3 – 6	4 – 7	5 – 7	6 – 7
Least time (days) :	6	18	26	16	15	6	7	7	3
Greatest time (days) :	10	22	40	20	25	12	13	9	5
Most likely time (days) :	8	20	33	18	20	9	10	8	4

i) Draw the network;
ii) Determine the expected task times and their variances;
iii) Determine the earliest and latest expected times to reach each node; and
iv) Identify the critical path and the expected time of completion of the project.

(Weightage 2×4=8)