# WEST BENGAL UNIVERSITY OF TECHNOLOGY

## CE-605A

## OPERATIONS RESEARCH

Time Allotted: 3 Hours | Full Marks: 70

*The questions are of equal value.*
*The figures in the margin indicate full marks.*
*Candidates are required to give their answers in their own words as far as practicable.*
*All symbols are of usual significance.*

### GROUP A
### (Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) Which of these is not a Operations Research Approach

(A) interdisciplinary (B) methodological

(C) wholistic (D) managerial

(ii) In a Linear Programming Problem (LPP), the objective function is to be

(A) maximised (B) minimised

(C) both (A) and (B) (D) maximised or minimised

(iii) If a Linear Programming Problem (LPP) has multiple solution the objective function is _____ to one of the constraint

(A) parallel (B) perpendicular

(C) intersecting (D) none of these

(iv) CPM is an Operations Research Technique. Full form of CPM is

(A) cost path method (B) critical path method

(C) cost per machine (D) none of these

(v) ABC Analysis is applicable in which branch of OR?

(A) linear programming problem (B) queuing theory

(C) game theory (D) inventory control

(vi) If Saddle Point exists in a game, then it is a problem of

(A) multiple strategy (B) mixed strategy

(C) one to one strategy (D) fixed strategy

(vii) If in queuing theory $\rho > 1$, then it is known as

(A) queue elongation (B) queue shortening

(C) constant queue (D) queue burst

(viii) AON in network analysis stands for

(A) activity on network (B) network on activity

(C) activity of network (D) network of activity

(ix) A m×n game ($m > 2, n > 2$) can be reduced to a $2 \times 2$ game by the method of

(A) graph (B) saddle point

(C) max & min (D) dominance

(x) If in a queuing system $\lambda$ is the average rate of customer arrival and $\mu$ is the service rate then

(A) $\lambda > \mu$ (B) $\lambda < \mu$

(C) $\lambda = \mu$ (D) $\lambda + \mu = 1$

(xi) If the number of variables in a Linear Programming Problem (LPP) exceeds 2 the method used is

(A) simplex (B) complex

(C) graphical (D) transportation

(xii) Redundant Constraint in a Linear Programming Problem (LPP)

(A) does not effect the feasible region

(B) effects the feasible region

(C) may or may not effect the feasible region

(D) diminishes the feasible region

(xiii) DijKstra's Algorithm is used to

(A) find maximum flow in a network

(B) find the shortest path form a specified vertex to another

(C) find the shortest path between any two vertices

(D) none of these

## GROUP B
## (Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Define Operations Research and discuss its features. 5

3. Use the graphical method to solve the following LPP 5

$$\text{Maximize} \quad Z = 3x + 2y$$
$$\text{Subject to:} \quad 2x + y \geq 2$$
$$3x + 4y \leq 12$$
$$x, y \geq 0$$

4. A has Re 1 and Rs 2 coins while B has Re 1, Rs 2 and Rs 5 coins. Both place coins simultaneously on the table. If both coins are same, A takes both of them while they are different B takes both of them. Draw the payoff matrix for the game. 5

5. In a railway marshalling yard, goods train arrives at the rate of 30 trains per day. If the average unloading time is 36 minute per train, calculate 5
(i) Expected queue size
(ii) Probability of queue size exceeding 10.

6. A company operating 50 weeks in a year is concerned about it stock of copper cable. This cost is Rs. 240 per meter and there is a demand for 8000 meters a week. Each replenishment cost Rs 1050 for administration and Rs 1650 for delivery, while holding cost are estimated at 25% of the value held a year. Assuming no shortages are allowed, find 5
(i) Optimal Order Quantity
(ii) Total Variable Inventory Cost
(iii) Total Inventory Cost.

## GROUP C
## (Long Answer Type Questions)

Answer any *three* questions. $3 \times 15 = 45$

7. (a) A farm is engaged in breeding goats. The goats are fed on various products grown on the farm. In view of the need to ensure certain nutrient constituents $N_1$, $N_2$ & $N_3$ it is necessary to buy two additional products $P_1$ & $P_2$. One unit of $P_1$ contains 36 units of $N_1$, 3 units of $N_2$ and 20 units of $N_3$ while one unit of $P_2$ contains 6 units of $N_1$, 12 units of $N_2$ and 10 units of $N_3$. The minimum requirement of $N_1$, $N_2$ & $N_3$ are 108 units, 30 units and 100 units respectively. Product $P_1$ costs Rs 20 per unit and $P_2$ costs Rs 40 per unit. Formulate the problem as an L.P. Problem and solve it graphically. 8

(b) The owner of a small machine shop has four mechanics available to be assigned to jobs. Five jobs are offered with the expected profit for each mechanic on each job as given in the table below. 7

Find the assignment of mechanics to jobs that will result in maximum profit

| Job→ / Mechanic ↓ | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 62 | 78 | 50 | 101 | 82 |
| 2 | 71 | 84 | 61 | 73 | 59 |
| 3 | 87 | 92 | 111 | 71 | 81 |
| 4 | 48 | 64 | 87 | 77 | 80 |

8. (a) Solve the following LPP by using simplex method 8

$$\text{Max } Z = X_1 + 2X_2 + X_3$$

Subject to

$$2X_1 + X_2 - X_3 \le 2$$
$$-2X_1 + X_2 - 5X_3 \ge -6$$
$$4X_1 + X_2 + X_3 \le 6;$$
$$X_1, X_2, X_3 \ge 0$$

(b) Find the dual of the problem 7

$$\text{Max } Z = 2X_1 + 3X_2 - 4X_3$$

Subject to

$$3X_1 + X_2 + X_3 \le 2$$
$$-4X_1 + 3X_3 \ge 4$$
$$X_1 - 5X_2 + X_3 = 5$$
$$X_1, X_2 \ge 0 \text{ and } X_3 \text{ is unrestricted in sign}$$

9. (a) Distinguish between Transportation problem and Assignment problem. 5

(b) A small project consists of seven activities. The details of these activities are given below (duration is in days). 10

| Activity | Immediate Predecessor | Most likely | Optimistic | Pessimistic |
|---|---|---|---|---|
| A | – | 3 | 1 | 7 |
| B | A | 6 | 2 | 14 |
| C | A | 3 | 3 | 3 |
| D | B, C | 10 | 4 | 22 |
| E | B | 7 | 3 | 15 |
| F | D, E | 5 | 2 | 14 |
| G | D | 4 | 4 | 4 |

Draw a network diagram for this project. Find the critical path and the expected project completion time.

10.(a) Define saddle point in a game. Explain how it is obtained. 5+10

(b) Solve the game

| | $B_1$ | $B_2$ |
|---|---|---|
| $A_1$ | –6 | 7 |
| $A_2$ | 4 | –5 |
| $A_3$ | –1 | –2 |
| $A_4$ | –2 | 5 |
| $A_5$ | 7 | –6 |

11.(a) Find the optimal solution and the corresponding cost of transportation for the following transportation problem. 8

| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Supply |
|---|---|---|---|---|---|
| $S_1$ | 19 | 20 | 50 | 10 | 7 |
| $S_2$ | 70 | 30 | 40 | 60 | 9 |
| $S_3$ | 40 | 8 | 70 | 20 | 18 |
| Demand | 5 | 8 | 7 | 14 | |

(b) In the production shop of a company the breakdown of the machine is found to be Poisson with an average rate of 3 machines per hour. Breakdown time of one machine costs Rs 40 per hour to the company. There are two choices before the company for hiring the repairman. One of the repairman is slow but cheap, the other is fast and expensive. The slow & cheap repairman demands Rs 20 per hour and will repair the breakdown machine exponentially at a rate of 4 per hour. The fast and expensive repairman demands Rs 30 per hour and will repair the breakdown machine exponentially at a rate of 6 per hour. Determine which repairman should be hired. 7