No. of Printed Pages : **4**

Sl. No.

BE10-R4 : APPLIED OPERATIONS RESEARCH

NOTE :

1. **Answer question 1 and any FOUR questions from 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time : 3 Hours **Total Marks : 100**

1. (a) The ABC manufacturing company can make two products P1 and P2. Each of the products requires time on a cutting machine and a finishing machine. Relevant data are :

	Product	
	P1	P2
Cutting hrs (per unit)	2	1
Finishing hrs (per unit)	3	3
Profit (per unit)	Rs. 6	Rs. 4
Maximum sale (Unit per week)	-	200

The number of cutting hours available per week is 390 and number of finishing hours available per week is 810. How much should be produced of each product in order to achieve maximum profit for the company. Formulate the problem as L.P.P.

(b) Players A and B play a game in which each player has three coins (Rs 2, Rs 5, Rs 10). Each of them selects a coin without the knowledge of the other person. If the sum of the coin is an odd number A wins B's coin. If the sum is even number, then B wins A's coin. Develop a payoff matrix of player A in this game.

(c) Find optimal solution of the following assignment problem using Hungarian method :

	I	II	III	IV
A	8	26	17	11
B	13	28	4	26
C	38	19	18	15
D	19	26	24	10

(d) A mobile repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in the order in which they came in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8 hour day. Find out :

(i) The probability that there is no unit in the system

(ii) Repairman's expected idle time

(e) Construct the project network with the following activities and relationships :

Activity	Predecessor	Duration
A	-	6
B	A	5
C	A	6
D	A	7
E	B	10
F	C, E	5
G	D	4

(f) Write the dual of the following linear programming problem :

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

Subject to

$$2x_1 + 3x_2 + 4x_3 \geq 2$$
$$3x_1 + x_2 + 7x_3 = 3$$
$$x_1 + 4x_2 + 6x_3 \leq 5$$

and $x_1, x_2, x_3 \geq 0$

(g) Use the graphical method to find an optimal solution of the following problem :

Maximize $Z = 10x_1 + 20x_2$

Subject to

$$5x_1 + 3x_2 \leq 30$$
$$3x_1 + 6x_2 \leq 36$$
$$2x_1 + 5x_2 \leq 20$$

and $x_1, x_2 \geq 0$ **(7x4)**

2. (a) Solve the following linear programming problem by dual simplex method :

Minimize $Z = 3x_1 + x_2$

Subject to

$$x_1 + x_2 \geq 1$$
$$2x_1 + 3x_2 \geq 2$$

and $x_1, x_2 \geq 0$

(b) A readymade garments manufacturer has to process 7 items through two stages of production, i.e. cutting and sewing. The time taken for each of these items at the different stages is given below in appropriate units.

		Items						
		1	2	3	4	5	6	7
Processing	Cutting	5	7	3	4	6	7	12
Time	Sewing	2	6	7	5	9	5	8

Find an order in which these items are to be processed through these stages so as to minimize the total processing time. **(9+9)**

3. (a) From the following traveling salesman problem, find the best cycle and find the total minimum cost.

	To City				
From City	A	B	C	D	E
A	∞	2	5	7	1
B	6	∞	3	8	2
C	8	7	∞	4	7
D	12	4	6	∞	5
E	1	3	2	8	∞

(b) Draw a network diagram from the following activity and find the critical path and total duration of the project.

Activity	Duration (Weeks)
1-2	2
1-3	5
1-4	5
2-4	1
2-5	5
3-4	4
3-5	6
4-5	5

(9+9)

4. (a) Use the concept of dominance to solve the following game :

		Player B					
		I	II	III	IV	V	VI
Player A	1	4	2	0	2	1	1
	2	4	3	1	3	2	2
	3	4	3	7	−5	1	2
	4	4	3	4	−1	2	2
	5	4	3	3	−2	2	2

(b) Solve the following integer linear programming problem by branch and bound method :

Maximize $Z = 6x_1 + 8x_2$

Subject to

$$4x_1 + 16x_2 \leq 32$$

$$14x_1 + 4x_2 \leq 28$$

and $x_1, x_2 \geq 0$ and are integers. **(9+9)**

5. (a) Define a basic feasible solution in a linear programming problem. Find all basic solutions of the following linear system of equations.

$$2x_1 + 3x_2 + 4x_3 = 5$$
$$3x_1 + 4x_2 + 5x_3 = 6$$

(b) A company has four plants A, B, C, D from which it supplies to three warehouses X, Y, Z. The number of units available at the plants A, B, C, D are 6, 10, 12, 15 and the demand at X, Y, Z are 11, 13, 19 respectively. The unit cost of transportation is given in the following table :

	A	B	C	D
X	19	14	23	11
Y	15	16	12	21
Z	30	25	16	39

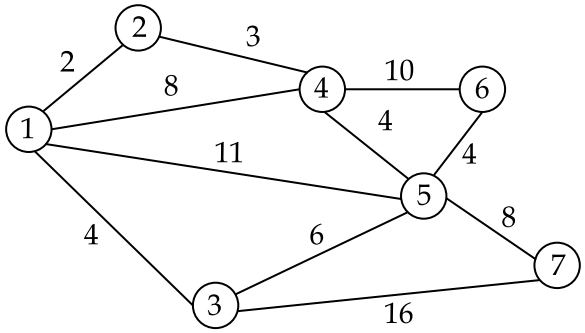
Find the optimal allocation so that the total transportation cost is minimum. **(9+9)**

6. (a) In a Bank, every 15 minutes one customer arrives for cashing the cheque. The staff in the only payment counter takes 10 minutes for serving a customer on an average. State suitable assumptions and find the following :
(i) Average queue length (ii) Increase in the arrival rate in order to justify the second counter (when the waiting time of a customer is at least 15 minutes the management will increase one more counter).

(b) Solve the following non-linear programming problem.
Max $f(x) = 2x_1\ x_2 + x_2 - x_1^2 - 2x_2^2$
Starting from the initial trial solution $(2x_1, x_2) = (1, 1)$,
Interactively apply the gradient search procedure with $\epsilon = 0.25$ to obtain the exact solution. **(9+9)**

7. (a) A manufacture has to supply his customers 600 units of his product per year. Shortages are not allowed and the inventory carrying cost amount to Rs 0.60 per unit year. The set up cost per run is Rs. 80. Find the following :
(i) The Economic order Quantity
(ii) The minimum average yearly cost
(iii) The optimum number of orders per year
(iv) The optimum period of supply per optimum order

(b) Explain Minimum spanning tree problem and from the following network, identify minimum spanning. **(9+9)**



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