QP Code : 31502

Time 3 Hours	Total marks 80

Instructions –
1. Question no. ONE is compulsory.
2. Attempt any THREE out of remaining FIVE questions.
3. Assume suitable data where ever necessary but justify the same.
4. Use of calculators, random number tables, normal distribution tables is permitted.
5. Use graph papers where ever necessary.

1. Attempt any Four of the followings: **(20)**
   a) Explain the terms – feasible solution, basic solution and degeneracy in the context of transportation problem.
   b) Explain the terms- i) inventory carrying cost ii) Optimal order quantity iii) Reorder point.
   c) Explain the terms – Bounded and Unbounded queues. What costs are taken into consideration when decisions made are based queuing theory?
   d) Write dual of following LPP.
   Maximize,
   $$Z = 3x + 5y + 4z$$
   Subject to,
   $$3x + 2y + 2z \leq 12$$
   $$2x + 2y + z \geq 8$$
   $$x + 2y + 3z = 15$$
   $$x, y \geq 0$$
   e) Solve the following games

		B	
	2	4	3
A	8	9	7
	-6	1	5

2. a) A company manufactures 30 units per day. The sale of these items depends upon demand which has the following distribution:

Sales (Units)	27	28	29	30	31	32
Probability	0.10	0.15	0.20	0.35	0.15	0.05

The production cost and sale price of each units are Rs 40 and Rs 50 respectively. Any unsold product is to be disposed off at a loss of Rs 15 per unit. There is a penalty of Rs. 5 per unit if demand is not met. Using the following Monte Carlo simulation technique, estimate the total profit/loss for the company for the next ten days. If the company decides to produce 29 units per day, what is the advantage or disadvantage to the company?   **(10)**
Random numbers –
1470 9283 6264 3555 9743 2506 7959 5352 6912 4167
7984 8579 2486 0788 8872 6599 9769 4629 3246 1781

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b) At a railway reservation booking window customers arrive randomly at the average rate of 16 per hour approximated to Poisson's distribution. If service time is exponentially distributed with a mean of 20 per hour, determine a) Percentage utilization of capacity b) Probability that there are at least 3 customers in the queue. c) Average time spent in the system d) Average number of customers waiting in the line e) Probability that there are 5 customers in the system.   (10)

3. a) For organizing four World Cup Cricket matches, Cricket clubs of five cities have sent their proposals. The earnings from each match in each city are likely to be different because of the participating teams and local support they enjoy. The expected revenues in lakhs of rupees are as given in following table. How the matches should be assigned to various cities to maximize the expected revenue.   (10)

		Matches			
		1	2	3	4
Cities	A	60	20	40	82
	B	57	35	44	92
	C	20	30	35	70
	D	45	25	64	100
	E	38	45	52	85

b) Solve the following problem using Two Phase method –   (10)
   Minimize,
   $$Z = 2x_1 + x_2$$
   Subject to,
   $$3x_1 + x_2 = 3$$
   $$4x_1 + 3x_2 \geq 6$$
   $$x_1 + 2x_2 \leq 4$$
   $$x, y \geq 0$$

4. a) Nagpur Orange Growers Association has three canning factories. Oranges are transported from four orchards. Transportation costs per ton, capacities of orchards and requirements of factories are given in the table. Determine the optimal transportation mix.   (10)

	Factories			Capacity
Orchards	1	2	3	4
A	3	7	8	30
B	1	4	8	30
C	5	2	5	40
D	10	3	2	50
Requirements	20	60	70	

b) A special purpose machine was purchased for Rs.10,000. The running cost per year and resale values are given in the following table:

Year	1	2	3	4	5	6	7	8
Running cost	2,000	2,100	2,300	2,600	3,000	3,500	4,100	4,600
Resale value	6,000	5,000	3,800	2,500	1,100	1,000	1,000	1,000

Considering rate of interest as 12%, determine the optimal replacement age.   (10)

5. a) Hamara Udyog produces large industrial equipment. The firm has received the following orders for its equipments –   **(10)**

Month	September	October	November	December
Units	2	3	4	3

The cost of production involves a set-up cost of Rs. 50 thousand and an average variable cost of Rs. 30 thousand per unit. Inventory holding cost is Rs. 5 thousand per unit per month. Due to restrictions of storage space not more than 5 units can held in inventory. Assume that the firm has no inventory at the beginning of September and does not wish to have any inventory at the end of December. What production schedule should be followed to minimize the cost?

b) A scooter manufacturer requires 40 units of a certain component per day in his assembly line operation. The component is manufactured in the factory itself at the rate of 60 units per day, it costs Rs.150 per unit and set up cost for each production run is Rs.15,000. Inventory carrying cost is Rs. 10 per unit per day. If no shortages are allowed, decide the optimal ordering quantity and total estimated system cost. Sketch the inventory system.   **(10)**

6. a) A chemical manufacturing company produces two products A and B. Each product passes through three processes. The processing time in hours for each of the two products in each process is given below:

Process	Product A	Product B
1	2	5
2	7	2
3	4	3

The total duration for which each process is available in a week are 30, 24, and 20 hours, respectively. Product A gives a profit of Rs 18 per unit and one unit of Product B gives Rs.15. Find the Quantities of A and B to be produced in the next week so as to maximize profits. Solve using SIMPLEX method.   **(10)**

b) Explain the terms – Payoff matrix in the context of Game theory and then solve the following games –   **(10)**

i)

		B		
		-4	3	1
	A	5	2	3
		-6	0	-2

ii)

		B		
		26	24	19
	A	15	20	22
		17	18	27

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