

(3 Hours)

[Total Marks : 80]

N.B: 1) Question No. 1 is compulsory

2) Attempt any THREE questions from remaining

3) Figures to the right indicate full marks

4) Answers to questions should be grouped & written together

Q.1 Attempt any four of the following:

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- A) State the general rules for formulating a dual LP problem from its primal.
- B) Define a waiting line. Give a brief description of the various types of queues.
- C) Give Johnson's procedure for determining an optimal sequence for processing n items on two machines.
- D) Discuss the various costs involved in an inventory model.
- E) State and explain Bellman's principle of optimality in Dynamic Programming.

Q.2 A) An electronic company produces three types of parts for automatic washing machines. It purchases casting of the parts from a local foundry and then finishes the part on drilling, shaping and polishing machines. The selling prices of parts A, B and C are Rs. 8, Rs. 10 and Rs. 14 respectively. All parts made cannot be sold. Castings for parts A, B and C respectively cost Rs. 5, Rs. 6 and Rs. 10. The shop possesses only one of each type of casting machine. Costs per hour to run each of the three machines are Rs. 20 for drilling, Rs. 30 for shaping and Rs. 30 for polishing. The capacities (parts per hour) for each part on each machine are shown in the table:

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Machine	Capacity per hour		
	Part A	Part B	Part C
Drilling	25	40	25
Shaping	25	20	20
Polishing	40	30	40

The management of the shop wants to know how many parts of each type it should produce per hour in order to maximize profit for an hour's run. Formulate this problem as an LP model so as to maximize total profit to the company.

- B) i) Explain the principle of dominance in Game Theory. 5
- ii) Two competitors A and B are competing for the same product. Their different strategies are given in the following payoff matrix: 5

		Company B			
		I	II	III	IV
Company A	1	8	10	9	14
	2	10	11	8	12
	3	13	12	14	13

Solve the above game problem using Dominance principle.

Q.3 A) Solve the following LP Problem by Simplex Method.

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$$\text{Maximize } z = 3x_1 + 2x_2 + x_3$$

Subject to $2x_1 + 5x_2 + x_3 = 12$
 $3x_1 + 4x_2 = 11$
 and $x_2, x_3 \geq 0$ and x_1 unrestricted

- B) Best-ride airlines that operates seven days a week has the following timetable. Crews must have a minimum layover of 5 hours between flights. Obtain pairing of flights that minimizes layover time away from home. For any given pairing, the crew will be based at the city that results in the smaller layover. For each pair also mention the city where crew should be based. 10

Flight No.	Mumbai - Delhi	
	Departure	Arrival
101	8:00 am	9:00 am
102	9:00 am	10:00 am
103	12:00 noon	1:00 pm
104	5:00 pm	6:00 pm

Flight No.	Delhi - Mumbai	
	Departure	Arrival
1	7:00 am	8:00 am
2	8:00 am	9:00 am
3	1:00 pm	2:00 pm
4	6:00 pm	7:00 pm

- Q.4 A) Use two-phase simplex method to solve the following LPP: 10

Minimize $Z = x_1 + x_2$
 Subject to $2x_1 + x_2 \geq 4$
 $x_1 + 7x_2 \geq 7$
 $x_1, x_2 \geq 0$.

- B) In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the interarrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average of 36 minutes. Calculate: 10

- expected queue size (line length)
- probability that the queue size exceeds 10

If the input of trains increases to an average of 33 per day, what will be the change in (i) and (ii)?

- Q.5 A) The demand for an item in a company is 18,000 units per year, and the company can produce the item at a rate of 3,000 per month. The cost of one set-up is Rs 500 and the holding cost of one unit per month is 15paise. The shortage cost of one unit is Rs 240 per year. Determine the optimum manufacturing quantity and the number of shortages. Also determine the manufacturing time and the time between set-ups. 10

- B) A group of process plants in an oil refinery are fitted with valves. Over a period of time the failure pattern of these 400 valves has been observed and it is as follows: 10

Months	:	1	2	3	4	5	6	7	8	Total
Number of valves falling:		8	20	48	104	120	56	32	12	400

It costs Rs 100 to replace each valve individually. If all the valves are replaced at a time, it costs Rs 50 per valve. Suggest an optimum replacement policy if the maintenance

department is considering following replacement policies:

- i. To replace all valves simultaneously at fixed intervals, in addition to replacing valves as and when they fail.
- ii. To replace valves as and when they fail.

Q.6 A) Solve the following Transportation Problem:

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Plant	Warehouse			Supply
	W1	W2	W3	
A	28	17	26	500
B	19	12	16	300
Demand	250	250	500	

B) A company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is given below:

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Production / day	196	197	198	199	200	201	202	203	204
Probability	0.05	0.09	0.12	0.14	0.20	0.15	0.11	0.08	0.06

The finished mopeds are transported in a specially designed three-storeyed lorry that can accommodate only 200 mopeds. Using the following 15 random numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54 and 10, simulate the process to find out

- i) What will be the average number of mopeds waiting in the factory?
- ii) What will be the number of empty spaces in the lorry?