sem-VII / mech / 20-12-10 / operations Research.

Con. 5888-10. (REVISED COURSE) GT–8778

(3 Hours) [Total Marks : 100

N. B. : (1) Question No. **1** is **compulsory**.
(2) Solve any **four** questions from the remaining **six**.
(3) Use of **calculator** and Graph paper is **allowed**.
(4) Figures to the indicate **full** marks.
(5) Assume **suitable** data wherever **required**.

1. Solve any **five** short notes on :— **20**
   (a) Duality Principle
   (b) Bounded and Unbounded solution in LPP
   (c) Game Theory
   (d) Bellman's Principle of Optimality
   (e) Inventory Models
   (f) Queuing Models
   (g) Johnson's Algorithm.

2. (a) A company manufacturing air coolers has, at present, firm orders for the next 6 months to meet orders an either regular or overtime basis. The order size and production costs over the next six monts are as follows : **10**

Month	1	2	3	4	5	6
Orders	640	660	700	750	550	650
Cost/unit (Rs.) Regular Production	40	42	41	45	39	40
Cost/unit (Rs.) Overtime Production	52	50	53	50	45	43

With 100 air coolers in stock at present, the company wishes to have atleast 150 air coolers in stock at the end of 6 months. The regular and overtime production in each month is not to exceed 600 and 400 units respectively. The inventory carrying cost for air coolers is Rs. 12 per unit per month. Formulate the L.P. model.

(b) Show by Simplex method, that the following L.P.P. has infinite number of non-basic feasible optimal solutions : **10**

Maximize $Z = 4x_1 + 10x_2$,
Subject to $2x_1 + x_2 \leq 10$,
$2x_1 + 5x_2 \leq 20$,
$2x_1 + 3x_2 \leq 18$,
$x_1, x_2 \geq 0$

3. (a) Use two phase method to **10**
Maximize $Z = 5x_1 + 3x_2$,
Suject to $2x_1 + x_2 \leq 1$
$x_1 + 4x_2 \geq 6$
$x_1, x_2 \geq 0$.

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(b) Solve the following problem using big M Method : **10**

Maximize $Z = 6x_1 - 3x_2 + 2x_3$

Subject to $2x_1 + x_2 + x_3 \leq 16$,

$3x_1 + 2x_2 + x_3 \leq 18$,

$x_2 - 2x_3 \geq 8$,

$x_1, x_2, x_3 \geq 0$.

4. (a) A dairy firm has three plants located throughout the state. Daily milk production at each plant is as follows : **10**

Plant 1 ..... 6 million litres,
Plant 2 ..... 1 million litres, and
Plant 3 ..... 10 million litres.

Each day the firm must fulfill the needs of its four distribution centres. Minimum requirement at each centre is as follows :

Distribution Centre 1 ..... 7 million litres
Distribution Centre 2 ..... 5 million litres
Distribution Centre 3 ..... 3 million litres, and
Distribution Centre 4 ..... 2 million litres.

Cost of shipping one million litres of milk from each plant to each distribution centre is given in the following table in hundreds of rupees.

		Distributed Centres			
		1	2	3	4
Plants	1	2	3	11	7
	2	1	0	6	1
	3	5	8	15	9

The dairy firm wishes to decide as to how much should be the shipment from which plant to which distribution centre so that the cost of shipment may be minimum. Also show that it represents a network situation.

(b) A machine operator has to perform three operations : turning, threading and knurling on a number of different jobs. The time required to perform these operations (in minutes) for each job is known. Determine the order in which the jobs should be processed in order to minimize the total elapsed time to turn out all the jobs. **10**

Job	Time for turning (minutes)	Time for threading (minutes)	Time for knurling (minutes)
1	3	8	13
2	12	6	14
3	5	4	9
4	2	6	12
5	9	3	8
6	11	1	13

5. (a) The following mortality rates have been observed for a certain type of light bulbs : **10**

End of week	1	2	3	4	5	6
Probability of failure to date	0·09	0·25	0·49	0·85	0·97	1·00

There are a large number of such bulbs which are to be kept in working order. If a bulb fails in service, it costs Rs. 3 to replace but if all the bulbs are replaced in the same operation, it can be done for only Rs. 0·70 a bulb. It is proposed to replace all bulbs at fixed intervals, whether or not they have burnt out, and to continue replacing burnt out bulbs as they fail.

(i) What is the best interval between group replacements ?

(ii) At what group replacement price per bulb, would a policy of strictly individual replacement become preferable to the adopted policy ?

(b) Trains arrive at the yard every 15 minutes and the service time is 33 minutes. If the line capacity of the yard is limited to 4 trains, find— **10**

(i) the probability that the yard is empty,

(ii) the average number of trains in the system.

6. (a) Solve the following game by using the principle of dominance. **10**

Player A \ Player B	I	II	III	IV	V	VI
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) A particular item has a demand of 9,000 units/year. The cost of one procurement is ₹100 and the holding cost per unit is ₹2·40 per year. The replacement is instantaneous and no shortages are allowed. Determine :— **10**

(i) the economic lot size,

(ii) the number of orders per year,

(iii) the time between orders,

(iv) the total cost per year if the cost of one unit is ₹ 1.

7. (a) Solve the following Dynamic Programming problem by LPP. **10**

Maximize $Z = 3x_1 + 4x_2$

Subject to $2x_1 + x_2 \leq 40$,

$2x_1 + 5x_2 \leq 180$,

$x_1, x_2 \geq 0$.

(b) (i) Find the value of π experimentally by Simulation. **10**

(ii) Discuss the types of Simulation models and Simulation Languages.
