Con. 3480–11.   RK–3300

(3 Hours)   [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
   (2) Attempt any **four** questions from the remaining **six** questions.
   (3) **Figures** to the **right** indicate **full** marks.
   (4) Assume **sutaible** data wherever **necessary**.

1. Give short notes on (any **four**) :–   **20**
   (a) Duality Principle
   (b) Degeneracy
   (c) Queueing Models
   (d) Game Theory
   (e) Inventory Models
   (f) Bellman's Principle of Optimality
   (g) Simulation Models
   (h) Travelling Salesman Problem.

2. (a) Sove the following problem by Graphical Method :–   **10**

   Maximize $Z = 40x_1 + 35x_2$

   Subject to

   $2x_1 + 3x_2 \leq 60$

   $4x_1 + 3x_2 \leq 96$

   $4x_1 + 3\cdot5x_2 \leq 105$

   $x_1, x_2 \leq 0$

   (b) A company has two grades of inspectors 1 and 2, who are to be assigned for a   **10**
   quality control inspection. It is required atleast 2000 pieces be inspected per
   8-hour day. A Grade 1 inspector can check pieces at the rate of 40 per hour,
   with an accuracy of 97%. A Grade 2 inspector checks at the rate of 30 pieces
   per hour with an accuracy of 95%.
   The wage rate of a Grade 1 inspector is Rs. 5 per hour while that of a Grade 2
   inspector is Rs. 4 per hour. An error made by an ispector costs Rs. 3 to the
   company. There are only nine Grade 1 inspectors and eleven Grade 2 inspectors
   available in the company. The company wishes to assign work to the available
   inspectors so as to minimize the total cost of the inspection. Formulate this
   problem as a Linear Programming Model.

3. (a) Solve by Simplex Method :–   **10**

   Maximize $Z = 4x_1 + 3x_2$

   st

   $2x_1 + x_2 \leq 1000$

   $x_1 + x_2 \leq 800$

   $x_1 \leq 400$

   $x_2 \leq 700$

   $x_1, x_2 \geq 0$

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(b)   A department has 5 employees with 5 jobs to be performed. The time (in hours)   **10**
each man will take to perform each job is given in the effectiveness matrix.

		Employees				
		I	II	III	IV	V
	A	10	5	13	15	16
	B	3	9	18	13	6
Jobs	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated, one per employee, so as to minimize the total
man-hours ?

4.   (a)   Find the sequence that minimizes the total elapsed time required to complete   **10**
the following tasks on two machines :—

Task	A	B	C	D	E	F	G	H	I
Machine I	2	5	4	9	6	8	7	5	4
Machine II	6	8	7	4	3	9	3	8	11

(b)   A firm is considering replacement of a machine, whose cost price is Rs. 12,200,   **10**
and the scrap value, Rs. 200. The running (maintenance and operating) costs
are found from experience to be as follows :—

Year	1	2	3	4	5	6	7	8
Running Cost (Rs.)	200	500	800	1200	1800	2500	3200	4000

When should the machine be replaced ?

5.   (a)   A company management and the Labour Union are negotiating a new 3 years   **10**
settlement. Each of these has four strategies :—

   I :   Hard and aggressive bargaining

   II :   Reasoning and logical approach

   III :   Legalistic strategy

   IV :   Conciliatory approach

The costs to the company are given for every pair of strategy choice.

		Company Strategies			
		I	II	III	IV
	I	20	15	12	35
Union	II	25	14	8	10
Strategies	III	40	2	10	5
	IV	−5	4	11	0

What strategies will the two sides adopt ? Also determine the value of the game.

(b)   Explain 'Deterministic Inventory Control Models'. Explain any one in detail with   **10**
an expression.

6.   (a) A television repairman finds that the time spent on his jobs has an exponential **10** distribution with mean 30 minutes. If he repairs sets in the order in which they came in, and if the arrival of sets follows a Poisson distribution approximately with an average rate of 10 per 8–hour day, what is the repairman's expected idle time each day ? How many jobs are ahead of the overage set just brought in ?

    (b) A bakery keeps stock of a popular brand of cake. Previous experience shows the **10** daily demand pattern for the item with associated probabilities, as given below :

Daily demand (number)	0	10	20	30	40	50
Probability	0·01	0·20	0·15	0·50	0·12	0·02

Use the following sequence of random numbers to simulate the demand for next 10 days.

Random Numbers : 25, 39, 65, 76, 12, 05, 73, 89, 19, 49.

Also estimate the daily average demand for the cakes on the basis of simulated data.

7.   (a) Determine the values of u_1, u_2 and u_3 so as to –   **10**

        Maximize $Z = u_1, u_2, u_3$

        Subject to the constaint

        $u_1 + u_2 + u_3 = 10$ and $u_1, u_2, u_3, 10.$

    (b) A dairy firm has three plants located throughout a state. The daily milk production **10** at each plant is as follows :–

        Plant 1 :   6 million litres

        Plant 2 :   1 million litres, and

        Plant 3 :   10 million litres.

Each day the firm must fulfil 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

        Distribution centre 4 : 2 million litres

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

		Distribution Centre			
		D1	D2	D3	D4
	P_1	2	3	11	7
Plant	P_2	1	0	6	1
	P_3	5	8	15	9

Solve the above problem by VAM method.

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