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B. Tech
HSSM 4301

Sixth Semester Examination – 2008

OPTIMIZATION IN ENGINEERING

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory
and any **five** from the rest.

The figures in the right-hand margin
indicate marks.

1. Answer the following questions : 2×10
- (a) What is feasible region ? Is it necessary that it should be always a convex set ?
- (b) Comment on the solution of the following LPP :

$$\begin{aligned} \text{Maximize} \quad & z = 4x_1 + 2x_2 \\ \text{Subject to} \quad & -x_1 + 2x_2 \leq 6 \\ & -x_1 + x_2 \leq 2 \\ \text{and} \quad & x_1, x_2 \geq 0 \end{aligned}$$

P.T.O.

(c) What are artificial variables ? Why do we need them ?

(d) Obtain the dual problem of the following primal LP problem :

$$\begin{aligned} \text{Maximize} \quad & z = x_1 - 3x_2 - 2x_3 \\ \text{Subject to} \quad & 3x_1 - x_2 + 2x_3 \leq 7 \\ & 2x_1 - 4x_2 \geq 12 \\ & -4x_1 + 3x_2 + 8x_3 = 10 \\ \text{and} \quad & x_1, x_2, x_3 \geq 0 \end{aligned}$$

(e) What do you mean by unbalanced transportation problem ? How do you handle such situation in order to find a solution ?

(f) Do you agree that an assignment problem is a special case of transportation problem ? Explain.

(g) Explain the difference between pure strategy and mixed strategy in a game.

(h) What is traffic intensity in a queuing system ? If traffic intensity is 0.3, then what is the percent of time a system remains idle ?

(i) Explain the different procedure to solve a problem using dynamic programming.

(j) Explain the concept of branch and bound method in integer programming.

2. A manufacturer of leather belts makes three types of belts, A, B and C, which are processed on three machines M1, M2, and M3. Belt A requires 2 hours on machine M1 and 3 hours on machine M2 and 2 hours on machine M3, belt B requires 3 hours on machine M1 and 2 hours on machine M2 and 2 hours on machine M3 and belt C requires 5 hours on machine M2 and 4 hours on machine M3. There are 8 hours of time per

day available on machine M1, 10 hours of time per day available on machine M2 and 15 hours of time per day available on machine M3. The profit gained from belt A is Rs. 3.00 per belt, from belt B is Rs. 5.00 and from belt C is Rs. 4.00 per unit. Formulate the problem into a linear programming problem and solve by Simplex method. 10

3. (a) A steel company has three open-hearth furnaces and five rolling mills. Transportation costs (rupees per quintal) for shipping steel from furnaces to rolling mills are shown in the following table :

Mills \ Furnaces	M1	M2	M3	M4	M5	Supply
F1	4	2	3	2	6	8
F2	5	4	5	2	1	12
F3	6	5	4	7	7	14
Demand	4	4	6	8	8	

Find the optimal shipping schedule. 6

- (b) Consider a problem of assigning four clerks to four tasks. The required time (in hours) for completion of the tasks by the clerks are given below :

task \ Clerk	A	B	C	D
C1	4	7	5	6
C2	-	8	7	4
C3	3	-	5	3
C4	6	6	4	3

Clerk C2 can not be assignee to task A and clerk C3 can not be assigned to task B. Find all the optimum assigned schedules. 4

4. Solve the following integer programming problem using Gomory's cutting plane algorithm

$$\text{Maximize } Z = x_1 + 2x_2$$

$$\text{Subject to } 2x_2 \leq 7$$

$$x_1 + x_2 \leq 7$$

$$2x_1 \leq 11$$

and $x_1, x_2 \geq 0$ and integers. 10

5. (a) Use dynamic programming to solve the following problem

$$\begin{aligned} \text{Minimize } & Z = y_1^2 + y_2^2 + y_3^2 \\ \text{Subject to } & y_1 + y_2 + y_3 = 10 \\ \text{and } & y_1, y_2, y_3 \geq 0 \end{aligned} \quad 6$$

- (b) Solve the following games by using maxmin (minmax) principle whose payoff matrix is given below. Include in your answer. 4

- (i) strategy selection for each player
(ii) the value of game to each player.

Player A strategy	Player B strategy			
	B ₁	B ₂	B ₃	B ₄
A ₁	1	7	3	4
A ₂	5	6	4	5
A ₃	7	2	0	3

6. (a) Customers arrive at a post office window, being manned by a single individual according to Poisson process with a

mean rate of 30 per hour. The time required to serve a customer has an exponential distribution with a mean of 90 seconds. Find the average waiting time of a customer. Also determine the average number of customers in the system and average queue length. 5

- (b) There are six jobs each of which must go through the machines A, B and C in the order ABC. Processing time (in hours) are given in the following table :

Job	1	2	3	4	5	6
Machine A	8	3	7	2	5	1
Machine B	3	4	5	2	1	6
Machine C	8	7	6	9	10	9

Determine a sequence of job that will minimize the elapsed time. 5

7. (a) A bakery shop keeps stock of a particular brand of cake. Previous experience

show the 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

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- (b) Write Bellman-Ford algorithm to find shortest path from one node to all other nodes in a graph having no negative dicycles.

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8. Write short notes of the followings with one example of practical application in each case.

- (a) Knapsack problem 3
- (b) Set covering problem 3
- (c) Set partitioning problem. 4