

Total number of printed pages – 10

B. Tech  
HSSM 4301

Fifth 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 a convex set ? What is the use of convex set in Linear programming ?
  - (b) What are slack variables ? Why do we need them ?

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- (c) Why do we say sensitive analysis as post-optimality analysis ?
- (d) Explain degeneracy in a linear programming problem.
- (e) Explain why dummy facility or job is sometimes required to solve an assignment problem successfully.
- (f) What are the advantages and disadvantages of North-West corner rule to find the initial solution of a transportation problem ?
- (g) How can you say an assignment problem is a special case of transportation problem ?
- (h) Explain the dominance rule in a game.
- (i) What is pure death process ? Give an example.
- (j) What is the difference between deterministic and probabilistic dynamic programming.

2. (a) Solve the following LLP by graphical method :

$$\begin{aligned} \text{Maximize } z &= 2x_1 + 4x_2 \\ \text{subject to } x_1 + 2x_2 &\leq 5 \\ x_1 + x_2 &\leq 4 \\ x_1, x_2 &\geq 0 \end{aligned}$$

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- (b) Using simplex method, solve the following LLP

$$\begin{aligned} \text{Maximize } z &= 2x_1 + x_2 - 3x_3 + 5x_4 \\ \text{Subject to } x_1 + 2x_2 - 3x_3 + 4x_4 &\leq 40 \\ 2x_1 - x_2 + x_3 + 2x_4 &\leq 8 \\ 4x_1 - 2x_2 + x_3 - x_4 &\leq 10 \\ x_1, x_2, x_3, x_4 &\geq 0 \end{aligned}$$

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3. (a) Write the principle of obtaining dual from the primal. Convert the following primal to dual.

4

$$\begin{aligned} \text{Maximize } z &= 3x_1 + 5x_2 \\ \text{subject to } 3x_1 + 2x_2 &\leq 10 \\ x_1 + 3x_2 &\leq 8 \\ 2x_1 - 4x_2 &\leq 5 \\ x_2 &\leq 2 \\ x_1, x_2 &\geq 20 \end{aligned}$$

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(b) A small manufacturer employs 5 skilled men and 10 semi-skilled men and makes an article in two qualities, a deluxe model and an ordinary model. The making of a deluxe model requires 2 hours work of a skilled man and 2 hours work by a semi-skilled man. The ordinary model requires 1 hour work by a skilled man and 3 hours work by a semi-skilled man. No man can work for more than 8 hours per day. The manufacturer's clear profit of the deluxe model is Rs. 10 and of the ordinary model is Rs. 8. Formulate the problem into a LPP model to maximize his profit. 6

4. (a) A product is produced by four factories A, B, C and D. The unit production cost in them are Rs.2, Rs3, Re1 and Rs5 respectively. Their production capacities

are : factory A – 50 units, factory B – 70 units, factory C – 30 units and factory D – 50 units. These factories supply the products to four stores, demand of which are 25, 35, 105 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given in the following table :

	Store 1	Store 2	Store 3	Store 4	
Factories	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Find the transportation matrix and find a basic feasible solution by Vogel's approximation method. 5

(b) Use dynamic programming to solve the following LPP

Maximize  $z = 3x_1 + 5x_2$

subject to  $x_1 \leq 4$

$x_2 \leq 6$

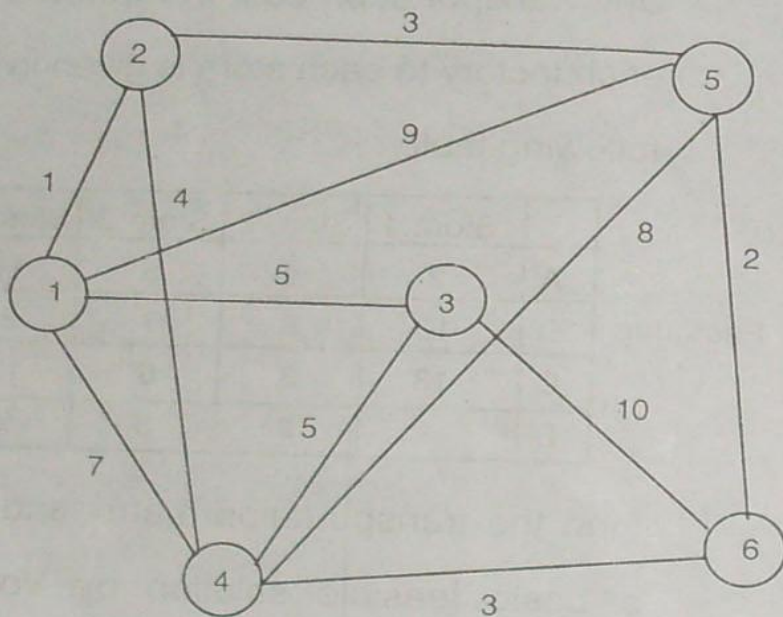
$3x_1 + 2x_2 \leq 18$

$x_1, x_2 \geq 0$

5

5. (a) Find the minimum spanning tree of the following network :

5



- (b) State the Dijkstra's algorithm to find the shortest path from the source node to any other node in a network. How is it different from Floyd's algorithm ?

5

6. (a) Arrival rate of telephone calls at a telephone booth are according to Poisson distribution with an average of 9 minutes between two consecutive arrivals. The length of telephone call is assumed to be exponentially distributed with mean 3 minutes.

- (i) Determine the probability that a person arriving at a booth will have to wait.  
(ii) Find the average queue length that is formed from time to time.  
(iii) Find the fraction of the day that the phone is in use.

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- (b) A company manufactures around 200 mopeds. Depending upon the availability of the raw materials and other conditions,



the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is given below :

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 special lorry, which can accommodate only 200 mopeds. Using the following 15 random numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 54, and 10 simulate the process to find out the average number of mopeds waiting in the factory. 5

7. (a) Six jobs have arrived at one time to be processed on a single machine as per the following data :

Job : A B C D E F

Processing time 7 6 8 4 3 5

Determine the followings : 5

- Optimal sequence
- Completion time of the jobs
- Mean flow time

- (b) Solve the following games by dominance and find the game value. 5

Player A strategy	Player B strategy			
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
A <sub>1</sub>	3	2	4	0
A <sub>2</sub>	3	4	2	4
A <sub>3</sub>	4	2	4	0
A <sub>4</sub>	0	4	0	8

8. (a) Write the algorithm of Hungarian method for solution of Assignment problem. 5

(b) Write short notes of the following : 5

(i) Cutting plane techniques in integer programming

(ii) Different queue discipline.