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BIMEE-004

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

00601

December, 2015

BIMEE-004 : OPTIMIZATION TECHNIQUES IN ENGINEERING

Time : 3 hours *Maximum Marks : 70*

***Note :** Answer any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

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1. (a) A company has three operational departments (weaving, processing and packaging) with capacity to produce three different types of clothes namely suiting, shirting and woollens yielding profit of ₹ 20, ₹ 40 and ₹ 30 per metre, respectively. One metre suiting requires 3 minutes in weaving, 2 minutes in processing and 1 minute in packing. One metre of shirting requires 4 minutes in weaving, 1 minute in processing and 3 minutes in packing while one metre of woollen requires 3 minutes in each department. In a week, total run time of each department is 60, 40 and 80 hours for weaving, processing and packaging departments, respectively. Formulate as Linear programming problem to maximize the profit.

(b) A company is manufacturing two different types of products A and B. Each product has to be processed in three different departments — casting, machining, and finally quality inspection. The capacity of the departments is limited to 35 hours, 32 hours and 24 hours, per week, respectively. Product A requires 7 hours in casting department, 8 hours in machining shop and 4 hours in inspection, whereas product B requires 5 hours, 4 hours, and 6 hours respectively in each shop. The profit contribution for a unit product of A and B is ₹ 40 and ₹ 30 respectively.

(i) Find the optimal quantities of products A and B.

(ii) What is the total profit contribution ? 7+7

2. (a) Solve the game whose pay-off matrix is

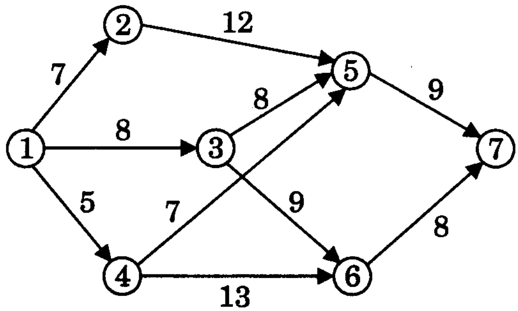
B

A		
	5	2
	3	4

Also calculate the game value.

(b) Differentiate between constrained and unconstrained problems with the help of an example. 7+7

3\. (a) Use dynamic programming to find the shortest path from city 1 to city 7 of the following route network. (Distance between the cities are given in kilometres)



(b) Use the Kuhn-Tucker conditions to solve the following problem :

Maximize $z = 2x_1 + x_2$

subject to :

$$-x_1 + x_2 \geq 0$$

$$x_1^2 + x_2^2 \leq 4$$

$$x_1, x_2 \geq 0$$ 7+7

4\. (a) Use the Newton-Raphson method to find the roots of the equation

$$x^3 - 2x - 5 = 0.$$

(b) Given the values :

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

Evaluate f(9) using Newton's divided difference formula. 7+7

5\. (a) Apply Runge-Kutta fourth order method to find an approximate value of y when x = 0·2, given that

$$\frac{dy}{dx} = x + y \text{ and } y = 1 \text{ when } x = 0.$$

(b) Evaluate $\int_0^6 \frac{1}{1+x^2}\,dx$, by using Trapezoidal rule. 7+7

6\. (a) Solve the following transportation problem to minimize the total transportation cost :

To Warehouse

		A	B	C	D	E	Plant Capacity
From Plants	1	1	2	6	2	3	800
	2	3	4	5	8	1	600
	3	3	1	1	2	6	200
	4	4	7	3	5	4	400
Demand		400	100	700	300	500	

(b) Find the maximum value of

$$z = 2x_1 + 3x_2$$

subject to :

$$x_1 + x_2 \leq 30$$

$$x_2 \geq 3$$

$$x_2 \leq 12$$

$$x_1 - x_2 \geq 0$$

$$0 \leq x_1 \leq 20$$

7+7

7. (a) What is dynamic programming ? What sort of problems can be solved by it ? Explain.

(b) What is simulation ? Describe its advantages in solving the problems. Give its main limitations with suitable examples. 7+7