BIMEE-004

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

Term-End Examination

00455   December, 2014

BIMEE-004 : OPTIMIZATION TECHNIQUES IN ENGINEERING

Time : 3 hours   *Maximum Marks : 70*

*Note : Answer any **five** of the following questions. All questions carry equal marks. Assume a suitable value for any missing data.*

1. (a) A length of wire 1 m long is to be divided into two pieces, one in a circular shape and the other into a square, having radius 'r' and of side 'b' respectively. What must the individual length be so that the total area is minimum ?   7

    (b) Determine the maximum value of the given function

$$f(x) = 2 \sin x - \frac{x^2}{10}$$

with an initial guess of $x_0 = 2.5$.   7

2. An office equipment manufacturer produces two kinds of products : Computer covers and floppy boxes. Production of either a computer cover or a floppy box requires 1 hour of production capacity in the plant. The plant has a maximum production capacity of 10 hours per day. Because of the limited sales capacity, the maximum number of computer covers and floppy boxes that can be sold are 6 and 8 per day respectively. The gross margin from the sales of a computer cover is ₹ 80 and ₹ 40 for a floppy box. The overtime hours should not exceed 2 hours/day. The plant manager has set the following goals arranged in order of importance :

(i) To avoid any under utilization of production capacity.

(ii) To limit the overtime hours to 2 hours.

(iii) To minimize the overtime operation of the plant as much as possible.

Develop a goal programming model for this problem. Also solve it. *14*

3. Consider the example of a manufacturer of animal feed who is producing feed mix for dairy cattle. The feed mix contains two active ingredients and a filler to provide bulk. One kg of feed mix must contain a minimum quantity of each of four nutrients as below :

Nutrient	A	B	C	D
Gram	90	50	20	2

The ingredients have the following nutrient value and cost :

	A	B	C	D	Cost/kg
Ingredient 1 (gram/kg)	100	80	40	10	40
Ingredient 2 (gram/kg)	200	150	20	–	60

What should be the amounts of active ingredients and filler in one kg of feed mix ? *14*

4. (a) Find the numerical solution on $0 \leq x \leq 1$ by Euler's method for *7*

$$y' = y^2 + 2x - x^4, \ y(0) = 0$$

(b) Compare the result obtained from the above question with exact solution $y = x^2$. *7*

5. (a) Find y in (0, 3) by solving the initial value problem $\qquad$ 7

$$y' = (x - y)/2, \ y(0) = 1$$

by using RK method (Runga Kutta) of order four with h = 1/2 & 1/2.

(b) Consider the system $\qquad$ 7

$$2x - y = 3$$
$$-x + 2y = 0$$

Solve it with the help of Jacobi's method.

6. (a) State the necessary and sufficient conditions for the maximum of a multi variable function. $\qquad$ 7

(b) Explain the procedure of Gauss-Newton method by using a suitable example. $\qquad$ 7

7. Write short notes on any *two* of the following : $\qquad$ 7+7

(a) Integer programming

(b) Recent advances in the field of optimization

(c) Unconstrained optimization

(d) Geometric programming