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BIMEE-004

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

Term-End Examination

00833

June, 2018

BIMEE-004 : OPTIMIZATION TECHNIQUES IN ENGINEERING

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. All questions carry equal marks. Assume suitable value for any missing data. Use of scientific calculator is permitted.*

1. (a) Explain the role of optimization techniques in manufacturing and business. 7

(b) Differentiate between deterministic and probabilistic models used as optimization methods. 7

2. (a) State the necessary and sufficient conditions for the maximization of a multi-variable function. 7

(b) What is decision-making ? Explain this under the conditions of certainty and uncertainty. 7

3. (a) Maximize

$$p = 3x + 4y$$

subject to

$$x + y \leq 4$$

$$2x + y \leq 5$$

$$x \geq 0,\ y \geq 0$$

Use simplex method to solve the problem. *8*

(b) Briefly describe the direct search method with suitable example. *6*

4. (a) Determine the maximum value of the given function

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

with an initial guess of $x_0 = 2{\cdot}5$. *8*

(b) Describe the Genetic Algorithm with suitable examples. *6*

5. (a) Evaluate *10*

$$\int_0^6 \frac{dx}{1 + x^2}$$ using

(i) Trapezoidal rule

(ii) Simpson's 1/3rd rule

(iii) Simpson's 3/8 rule

(b) How do you execute the Sequential Quadratics Programming implementation ? 4

6. (a) Perform four iterations of the Jacobi method for solving the following system of equations :

$$\begin{bmatrix} 5 & 2 & 2 \\ 2 & 5 & 3 \\ 2 & 1 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ -6 \\ -4 \end{bmatrix}$$

with $x^{(0)} = 0$

Exact solution is

$x = (1 \; -1 \; -1)^T$. 9

(b) Describe the geometry cutting plane method. 5

7. An office equipment manufacturer produces two kinds of products : computer covers and CD boxes. Production of either a computer cover or a CD 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 CD 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 CD 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*

8. Write short notes on any ***four*** of the following : $4 \times 3\frac{1}{2} = 14$

(a) Heuristic Methods

(b) Pure and Mixed Strategy in Theory of Games

(c) Stochastic Programming

(d) Constrained Optimization

(e) Lagrange Multiplier Method

(f) Kuhn-Tucker Necessary Conditions