Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-III Regular Examination January 2011

Subject code: 730801

Subject Name: Engineering Optimization

Date: 08 /01 /2011 **Time: 02.30 pm – 05.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain the significant requirement and importance of Gradient based search methods. **07**

(b) For a mechanical system shown in figure 1, find the displacements of the masses, under the action of an excitation P, using an appropriate method. Also verify the sufficiency condition. **07**

Q.2 **(a)** A uniform column of rectangular cross section is to be designed and constructed for supporting a water tank of mass M as shown in figure 2. It is required to minimize the mass of the column for economy and at the same time to maximize the natural frequency of transverse vibration of the system for avoiding possible resonance due to wind. Formulate the problem of designing the column to avoid failure due to direct compression and buckling. Assume the permissible compressive stress to be σ_{max}, modulus of elasticity E and moment of inertia I. The natural frequency of transverse vibration is given by, **07**

$$\omega = \left[\frac{3EI}{(M + \frac{33}{140}m)l^3} \right]^{1/2}$$

(b) Find the minimum of $f = x(x-1.5)$ in the interval (0,1) to within 10% of the exact value using Dichotomous search method. Use the ratio of final to initial intervals of uncertainty as: **07**

$$\frac{L_n}{L_0} = \frac{1}{2^{n/2}} + \frac{\delta}{L_0}\left(1 - \frac{1}{2^{n/2}}\right)$$

Where L_0 is the original and L_n is the final interval of uncertainty, n being the number of experiments.

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(b) Using the same data of question No. 2(b) above apply the method of Interval Halving. The interval of uncertainty remaining at the end of n experiments is given by, $L_n = \left(\frac{1}{2}\right)^{(n-1)/2} L_0$, where L_0 is the original interval of uncertainty. **07**

Q.3 **(a)** Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius. **07**

(b) State Kuhn-Tucker conditions giving a suitable example. **07**

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Q.3 **(a)** Explain with the help of a sketch an iterative process of Secant method. **07**

(b) State the characteristics of a Hessian matrix with its application in optimization. **07**

Q.4 **(a)** Explain Golden section method. **07**

(b) A beam of uniform rectangular cross section is to be cut from a log having a circular cross section of diameter d. The beam has to be used as a cantilever beam having fixed length to carry a concentrated load at the free end. Find the dimensions of the beam that correspond to the maximum tensile stress carrying capacity using the method of Lagrange multipliers. **07**

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Q.4 **(a)** Design a vertical cylindrical tank to have a minimum surface area for the tank closed at both the ends to maintain a fixed volume V. Find the percentage change in area due to 10 % change in height. **07**

(b) Discuss Geometric Programming and explain how lower bound is obtained? **07**

Q.5 **(a)** We wish to design a rectangular box of size LxBxH- m^3. The cost of transporting a load is given by 40/LBH and Material & Labor cost for bottom/top & sides are (10LB+20LH+40HB). Find lower bound of total cost and the dimensions of the box. **07**

(b) Enlist unconstrained optimization methods. Explain only features of any two closely related methods. **07**

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Q.5 **(a)** A coal supply hopper of height h is made up of sheet metal having truncated pyramid with square top of size axa and square bottom bxb is required to be designed to maximize its volume such that the total surface area is equal to 10π square meter. Formulate the problem. **07**

(b) Find the dimensions of the hopper of the problem Q5(a) above using the method of Lagrange multipliers. **07**

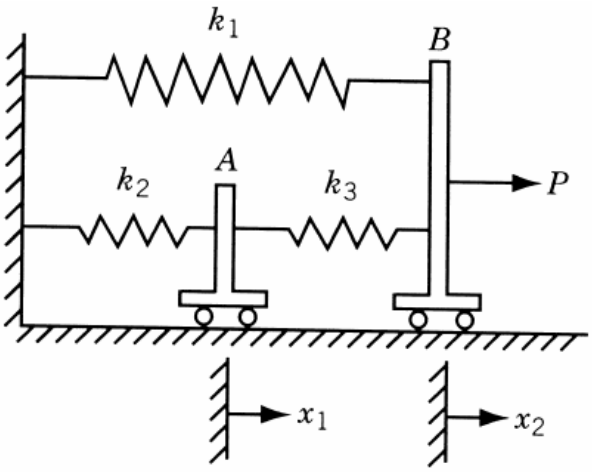

Figure 1 [Question No. 1(b)].

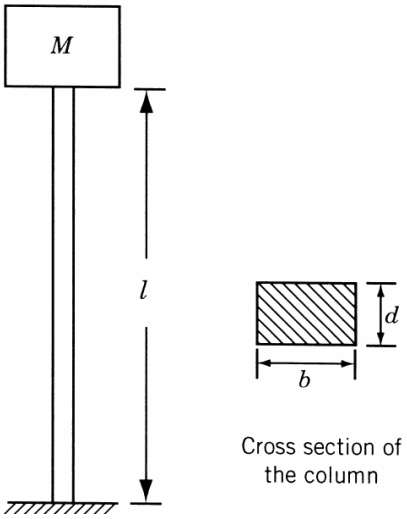

Figure 2 [Question No. 2(a)].

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