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Optimization Techniques
(1060)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Answer **any five** question.
5. Figure to the right indicate full marks.
6. Use of non-programmable calculator is allowed.

1. a) Optimize the dimension 'd' and 'f ' column for minimize the cost of column by using graphical method. **10**

Function - $F(x) = (9.82d * t) + (2 * t)$

Subject to - $d * f \geq 1.593$ ----- (i)

$(d * f)(d^2 + f^2) \geq 47.3$ ----- (ii)

$2 \leq d \leq 14$ ----- (iii)

$0.2 \leq f \leq 0.8$ ------ (iv)

b) A uniform column of rectangular c/s is to be constructed for supporting a water tank of mass 'M'. It is required to minimize the mass of the column for economy and miximize natural frequency. 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}. **10**

Take – natural frequency of transverse vibration.

$$f_n = \left[\frac{3EI}{\left\{ M + \frac{33}{140} m \right\} \ell^3} \right]^{1/2}$$

2. a) Find the second order Taylor's series approximation of the function **10**

$f(x_1\ x_2\ x_3) = x_2^3 x_3 + x_1 e^{x_3}$

about the point $x = \{1\ 0\ -2\}$

b) Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius. **10**

3\. a) Maximize $F = x_1 + 2x_2 + x_3$ **10**

Subject to $2x_1 + x_2 - x_3 \le 2$ ------- (i)

$-2x_1 + x_2 - 5x_3 \ge -6$ ------- (ii)

$4x_1 + x_2 + x_3 \le 6$ ------ (iii)

$x_i \ge 0 \quad i = 1, 2, 3$ ------ (iv)

Using pivot element method.

b) Minimize $f = 2x_1 + 3x_2 + 2x_3 - x_4 + x_5$ **10**

Subject to $3x_1 - 3x_2 + 4x_3 + 2x_4 - x_5 = 0$

$x_1 + x_2 + x_3 + 3x_4 + x_5 = 2$

$x_i \ge 0 \quad i = 1 \text{ to } 5$

4\. a) Find the minimum of the function **10**

$$f(\lambda) = 0.65 - \frac{0.75}{1+\lambda^2} - 0.65\lambda \tan^{-1}\left(\frac{1}{\lambda}\right)$$

using quasi-Newtons method with starting point $\lambda_1 = 0.1$ and the step size $\Delta\lambda = 0.01$. Use $\in = 0.01$ for checking the convergence.

b) Explain Secant Method in detail. **10**

5\. Minimize $F(x_1\ x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point $x_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ using steepest descent method. **20**

6\. a) Perform two iteration of Newton's method to minimize the function. **10**

$f(x_1 x_2) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$ from the starting point $\begin{Bmatrix} -1.2 \\ 1.0 \end{Bmatrix}$.

b) Minimize $F(x_1\ x_2) = \frac{1}{3}(x_1 + 1)^3 + x_2$ **10**

Subject to $g_1(x_1\ x_2) = 1 - x_1 \le 0$

$g_2(x_1\ x_2) = -x_2 \le 0$

by using exterior penalty function method.

7\) Minimize $f(x_1\ x_2\ x_3) = (x_1 - x_2)^2 + (x_2 - x_3)^4$ **20**

Subject to $g_1(x) = x_1(1 + x_2^2) + x_3^4 - 3 = 0$

$-3 \le x_i \le 3 \quad i = 1, 2, 3$

using GRG method, compute only x_1 & find GR & identify weather x_1 is optimum or not. Find optimal step length by using steepest descent method 'λ'.

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