Roll No. 2k 29/EE/30

THIRD SEMESTER   B.Tech.[EE]

END SEMESTER EXAMINATION   (Nov.-2022)

MA-261 NUMERICAL AND ENGINEERING OPTIMIZATION METHOD

Time: 3 Hours   *Max. Marks:40*

Note: Answer *ALL* questions. All questions carry equal marks. Assume suitable missing data, if any and clearly mention the assumptions.

Q.1 Answer all the following questions:

[a] Find the input output relationship of the circuit given in Figure.1 in terms of a linear differential equation. Using **Runge-Kutte fourth order** method write a MATLAB program and obtain a solution for the differential equation for t= 0 sec to t=0.6 seconds with step size 0.2. Assume initial condition $y(0)=2$, R1= 30kΩ, R2=20kΩ, C=100μF, Vin =20volts.

[4] CO1
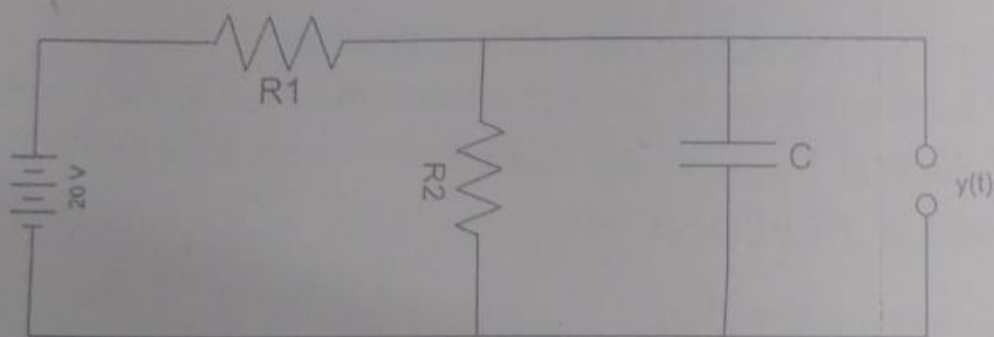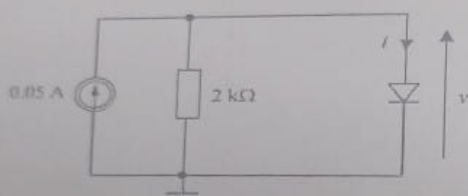
Figure.1

[b] What are the necessary and sufficient conditions for unconstrained one-dimensional optimization techniques? [2] CO3

[c] Explain the concept of random search method for unconstrained optimization methods. [2] CO3

Q.2 Attempt any TWO questions out of the following:

[a] Find a positive root of equation $\log x = 3x + \sin x$ by bisection method. [4] CO1

[b] Given the circuit shown, where the diode is described by the equation

$$i = 10^{-15}(e^{38v} - 1)$$

Assuming $v_0 = 0$, apply Newton Raphson Method to calculate the value of voltage v. [4] CO1

[c] Maximize the function $f(x,y) = 50x + 100y$ using graphical method under the constraints $10x + 5y \leq 2500$, $4x + 10y \leq 2000$, $x + 1.5y \leq 450$, $x \geq 0$, $y \geq 0$. [4] CO2

Q.3 Attempt any TWO questions out of the following:

[a] Write MATLAB program to find the minimum value of $f(x) = x^2 + 2x$ within the interval $[-3,4]$ using Fibonacci method. Obtain the optimal value within 5% of exact value. [4] CO3

[b] Minimize following function

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

Apply golden section search method in the interval $[0 \quad 3]$ with 6 iterations. [4] CO3

[c] Find the minimum of the function $f = (\lambda/\log \lambda)$ by using quadratic interpolation method (take the initial trial step length as 0.1).

3

[4] Co3

Q.4 Attempt any TWO questions out of the following:

[a] Minimize $f(x_1, x_2) = 6x_1^2 - 6x_1x_2 + 2x_2^2 - x_1 - 2x_2$ using steepest descent method starting from the point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$.

[4] Co3

[b] Find the value of [x,y] using Newton-Raphson technique to solve F1(x,y)=x^2+ xy+ y^2- 7 and F2(x,y)=x^3- y^3- 9 with initial condition [x,y]=[1.5,0.5].

[4] Co3

[c] Explain pattern search method for unconstrained n dimensional optimization.

[4] Co3

Q.5 Attempt any TWO questions out of the following:

[a] Find the optimum values of x_1 and x_2 using the Kuhn-Tucker conditions to minimize the given function.

$f(x_1, x_2) = x_1^2 + x_2^2 - 2x_1 - 4x_2$

subject to $g_1(x_1, x_2) = x_1 + 4x_2 - 5 \leq 0$,

$g_2(x_1, x_2) = 2x_1 + 3x_2 - 6 \leq 0$,
$g_3(x_1, x_2) = - x_1 \leq 0$,
$g_4(x_1, x_2) = - x_2 \leq 0$

starting from the point $X_1 = \begin{Bmatrix} 1.0 \\ 1.0 \end{Bmatrix}$.

[4] Co3

[b] Apply Penalty function method to minimize

$f(x_1, x_2) = \frac{1}{3}(x_1 + 1)^3 + x_2$

subject to $g_1(x_1, x_2) = -x_1 + 1 \leq 0$

$g_2(x_1, x_2) = -x_2 \leq 0$

[4] Co3

[c] Apply unidirectional search method and maximize $f(x, y, z) = x + 2y + z$ subject to $2x + y - z \leq 2, -2x + y - 5z \geq - 6, 4x + y + z \leq 6,$ x $\geq 0, y \geq 0, z \geq 0$

[4] co3