Department of Mechanical Engineering, IIT Bombay

ME 782 Design Optimization, Assignment #2, August 8, 2024

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1. Determine the roots of the following system of nonlinear algebraic equations:

(a)
$$f_1(x) = 3x_1^2 + 12x_2^2 + 10x_1 = 0$$
$$f_2(x) = 24x_1x_2 + 4x_2 + 3 = 0$$

(b)
$$f_1(x) = 1 - \frac{10}{x_1^2 x_2} = 0$$
$$f_2(x) = 1 - \frac{2}{x_1 x_2^2} = 0$$

(c)
$$f_1(x) = 5 - \frac{x_1 x_2}{8} - \frac{x_2^2}{4x_1^2} = 0$$
$$f_2(x) = -\frac{x_1^2}{16} + \frac{x_2}{2x_1} = 0$$

(d)
$$f_1(x) = 10x_1^3 - 10x_1 - x_2 - 2 = 0$$
$$f_2(x) = 2x_2^3 - 10x_2 - x_1 - 3 = 0$$

(e)
$$f_1(x) = x_1^2 + x_2^2 - 2 = 0$$
$$f_2(x) = 10x_1^2 - 10x_2 - 5x_1 + 1 = 0$$

2.Determine any one root of the following transcendental equations using bisection method:

(a) $\sin(x) - x\cos(x) = 0$

(b) $4\sin x - e^x = 0$

© $3\cos x - \cosh x = 0$

(d) $e^x \sin x - \frac{x}{2} = 0$

(e) $2\sinh x - \cosh x = 0$