

CoE 3SK4 Computer-Aided Engineering
Midterm 2004
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1. This exam is nominally 50 minutes long.
2. Do all four problems.
3. Show all steps and justify your answers. Otherwise, only partial credit will be given.
4. **Return this question paper with your solution.**

Problem 1.

(9 Points) Consider the system $Ax=b$ where

$$A = \begin{bmatrix} 2 & 1 & 3 \\ 3 & 3/2 & -1/2 \\ -1 & 1 & 2 \end{bmatrix} \quad \text{and} \quad b = \begin{bmatrix} 11/2 \\ 13/4 \\ 0 \end{bmatrix}$$

- (a) Is the solution to this system unique?
- (b) If the solution is unique, use Gauss elimination to find it. If the solution is not unique, give one solution to the system.

Problem 2.

(8 Points) We wish to find the value of θ that satisfies

$$\frac{3}{2}(\theta - \sin \theta) = \pi$$

- (a) Derive the iterative formula that uses Newton-Raphson Method to find θ .
- (b) Perform two iterations with your formula and the initial guess of $\theta = 2.5$ radians. What is the value of θ after two iterations? Calculation results should have 4 significant figures.

Problem 3.

(8 Points) Find the minimum value of function $f(x)$ below using Golden Search method starting with $x_l = 0$ and $x_u = 2$.

$$f(x) = 0.5 - xe^{-x^2}$$

- (a) Without performing any iterations, find the value of the search interval $x_u - x_l$ after 10 iterations.
- (b) Perform the first three iterations.

Problem 4.

(5 Points) Given function

$$f(x) = 2x^4 - \sin x - 20$$

Find the 2nd and 3rd order McLaurin series expansions of $f(x)$.