

# Question Type 1

Please write the question type number on the booklet

---

## Computational Methods for Engineers (MSE 390) – Mid-Term Exam

Wednesday, February 26th, 2014, 12:30pm, Room 3170

Non-programmable calculators may be used

No smartphones or other electronic devices may be used

One page (8.5" x 11", one side) of handwritten notes is permitted

All writing must stop at or before 2:15pm and exam booklets handed in

**Problem 1 (10 marks):** Specify the number of significant digits of the following numbers (no explanation required):

- a) 4523.22
- b)  $2.3600 \times 10^5$
- c)  $2.36 \times 10^5$
- d) 0.0005879

**Problem 2 (10 marks):** True or False (no explanation required):

- a) Decreasing the step size leads to decreasing the round-off error.
- b) Decreasing the step size leads to increasing the truncation error.
- c) Bracketing methods are usually faster than open methods.
- d) The smaller matrix condition number means the more accurate solution.

**Problem 3 (20 marks):** Use zero- through third-order Taylor series expansions to predict  $f(1.5)$  for  $f(x) = e^{1.1x}$  using a base point at  $x = 1$ . Compute the true percent relative error  $\epsilon_t$  for each approximation. Use five significant digits.

**Problem 4 (30 marks):** Use the Newton-Raphson method to find the root of

$$f(x) = e^{-0.5x}(4 - x) - 2$$

Employ initial guesses of (a) 2, (b) 6, and (c) 8. Explain your results.

Note: Use at least 6 significant digit and if possible 6 iterations.

**Problem 5 (30 marks):** Solve the following system of equations by LU decomposition **with** pivoting.

$$x_1 + x_2 + x_3 = 1$$

$$4x_1 + 3x_2 - 1x_3 = 6$$

$$3x_1 + 5x_2 + 3x_3 = 4$$

Note: Include all the details because they have their own marks.