16 March 2014

Test 1, Part 1 of 2

Name: _____

Time: 45 minutes
Answer all questions in English. Please show your work clearly. If your solution requires iterations, please stop after 4 iterations or approximated error less than 10^{-3}.

1. [**10%**] Use zero- through third-order Taylor series expansions to predict $f(2.5)$ for

$$f(x) = 15x^3 - 3x^2 + 4x - 67$$

using a base point at x = 1.5. Compute the true percent relative error at each approximation. What can you conclude about the error? Is the use of third-order Taylor series good enough to approximate the above polynomial? Why or why not?

2. [**40%**] Figure 1a shows a uniform beam subject to a linearly increasing distributed load. The equation for the resulting deflection, y is (see Figure 1b)

$$y = \frac{w_0}{120EIL}\left(-x^5 + 2L^2x^3 - L^4x\right)$$

   a. From the Figure 1(b), it can be seen that the maximum deflection occurs at x between 25% and 50% of length L. Determine the accurate location of x using your preferred numerical method. State the reasoning for your choice.
   b. At maximum deflection location, is the deflection, y sensitive to beam length, L or material property, E? State your reasons.

Use these parameter values in your computation: L = 700 cm, E = 60,000 kN/cm^2, I = 30,000 cm^4 and w_0 = 2.5 kN/cm.

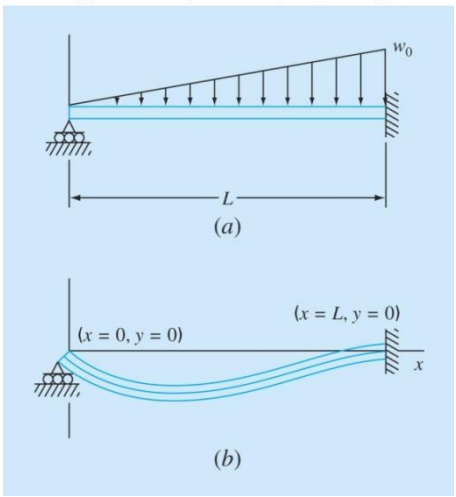

Figure 1: (a) A beam under linearly increasing distributed load.
(b) The resulting deflection.

Please return this question sheet together with the answer booklet.