

Tutorial 2

INSTRUCTIONS

- Tutorial problems need to be worked on during the tutorial session. **The deadline for submission is midnight on the same day.**
- You are strongly encouraged to write a computer program in Matlab to solve the equations. If this is not possible (for instance, because you do not have a PC/laptop), you should write a pseudocode and workout iterations manually as much as possible.
- **You must conduct a comprehensive analysis of the problem from both physical and numerical perspectives. You should experiment and explore the effects of different parameters/variables and understand and discuss the physics of the problem. These must be included in the report. Please also write down what you learnt from solving each problem.**
- Please submit all documents (including writeup, report, Matlab program files) in a single ZIP file. Name the zip file as: Rollnumber.zip. For example, if your roll number is 18110110, name your submission as 18110110.zip.

Problem T1*

Real mechanical systems may involve the deflections of non-linear springs. In Figure below, a mass m is released a distance h above a non-linear spring. The resistance force F of the spring is given by

$$F = -\left(k_1 d + k_2 d^{\frac{3}{2}}\right)$$

Conservation of energy can be used to show that

$$0 = \frac{2k_2 d^{\frac{5}{2}}}{5} + \frac{1}{2}k_1 d^2 - mgd - mgh$$

Solve for d , given the following parameter values. $k_1 = 50,000 \frac{\text{g}}{\text{s}^2}$, $k_2 = 40 \frac{\text{g}}{\text{s}^2 \text{m}^{0.5}}$, $m = 90 \text{ g}$, $g = 9.81 \frac{\text{m}}{\text{s}^2}$, $h = 0.45 \text{ m}$. You are required to compare the performances of graphical method, bisection method, and Newton-Raphson method for this problem.

