MEEN 644 – Numerical Heat Transfer and Fluid Flow
Spring 2019
HOMEWORK SET #1

Name _____

Instructor: N. K. Anand

Due Date: February 5, 2019

Maximum Points: 100

Consider an oscillation of a simple pendulum of length ℓ and mass m. The equation of motion is described by,

$$\mathrm{m}\frac{\mathrm{d}^2\theta}{dt^2} + \frac{mg\sin\theta}{\ell} = 0$$

where, m = 1 kg and ℓ = 1 m.

The Pendulum is initially displaced to 20°, and let go from the rest position to oscillate. Assume that there is no friction and the oscillation is not damped.

(a) Starting with $\Delta t = 0.5$ sec as the time step of integration, calculate displacement (radians) and angular velocity in (radian/sec) using the Runge-Kutta Second Order method. Stop your calculation at the end of one cycle. **– 50 points**

(b) Continue calculations made in step (a) by systematically decreasing the step size Δt by half. Declare grid independence when the relative change in displacement and angular velocity with successive time steps vary less than 10^{-4}. Plot your results. **-20 Points**

(c) Using the Δt corresponding to the grid independent solution (step b), calculate displacement and angular velocity for one cycle using Euler explicit and Euler implicit methods. **– 30 Points**