ME EN 2450 Assignment HW 5

Name: _____

I declare that the assignment here submitted is original except for source material explicitly acknowledged.

I also acknowledge that I am aware of University policy and regulations on honesty in academic work, and of the disciplinary guidelines and procedures applicable to breaches of such policy and regulations, as contained in the University website.

Name	Date
Signature	Student ID

Score

Total: /25

Exercise 1 (10 pts)

Solve the following system of first-order ODEs:

$$\frac{dy}{dt} = -2y + 4e^{-t}$$
$$\frac{dz}{dt} = -\frac{yz^2}{3}$$

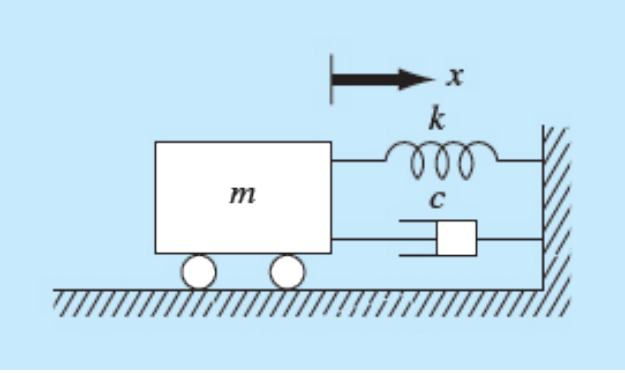
over a time from 0 to 1, $h = 0.1$, with $y(0) = 2$ and $z(0) = 4$. Use (a) Euler's and (b) fourth-order Runge Kutta. Submit a plot (in the pdf) of $y(t)$ and a separate plot for $z(t)$. On each plot, include the results from both methods. Include ALL your code in the submission PDF.

Exercise 2 (15 pts)

The motion of a damped spring-mass system is described by the following ODE:

$$m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx = 0$$

where x = displacement from equilibrium position [m], t = time [s], $m = 20$ [kg] mass, and c is the damping coefficient [N s/m]. The damping coefficient, c, takes on three values: 5 (underdamped), 40 (critically damped), and 200 (overdamped). The spring constant $k = 20$ N/m. The initial velocity is zero, and the initial displacement $x = 1$ [m]. Solve this IVP using a numerical method over the time period $0 \leq t \leq 15$ [s] **(Use the step size h = 0.1 [s])** Plot the displacement versus time for each of the three values of the damping coefficient on the same plot. Submit your plot in the pdf along with a statement about the characteristic differences in system behavior among the three damping coefficients. Include ALL your code in the submission PDF.



Hint: Before you start any coding, you need to first convert the ODE into a system of 1st-order ODEs and then put all equations into the *Standard Form.*