ECE 667 Homework 1
Due Thursday September 16, 2021

1. With a step size of $\Delta t = 0.1$ seconds use the Second Order Runge-Kutta method to determine the values of $x_1(t)$ and $x_2(t)$ at 0.4 seconds. Use initial (t=0) values of $x_1(0) = x_2(0) = 1$.

$$\dot{x}_1 = \frac{2}{3}x_1 - \frac{4}{3}x_1 x_2$$
$$\dot{x}_2 = x_1 x_2 - \frac{1}{2}x_2$$

2. Repeat problem 1 except use the Second Order Adams-Bashforth method. With this approach use the t=0 and t=0.1 values from Problem 1 for the starting values, and then start your integration at t=0.2 seconds.

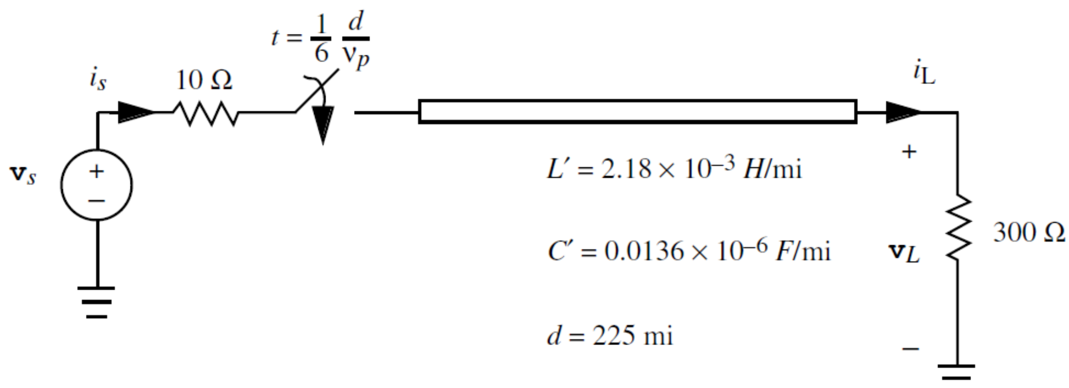
3. Give two equilibrium points for the Problem 1 system.

4. Write and use a computer program utilizing the Second Order Runge-Kutta method to solve the below initial value problem. You may write this program in the language of your choice, including packages that have built-in capability for integrating differential equations (such as Matlab or Mathematica). However, if you use such a package you may not use this built-in capability; you must manually code the integration method. Turn in a listing of your program. Use an initial value $x_1=x_2=x_3 = 5$. Use $\Delta t = 0.1$ seconds. Integrate your equations long enough so you can describe the system behavior, including whether it converges to the equilibrium point. What is an equilibrium point?

$$\dot{x}_1 = 8\left(x_2 - x_1\right)$$
$$\dot{x}_2 = x_1(28 - x_3) - x_2$$
$$\dot{x}_3 = x_1 x_2 - \frac{4}{3}x_3$$

5. Book 2.3 (see below) except change the left resistance to 6 Ω.

2.3 Given the sinusoidal source and de-energized lossless transmission line shown: draw the "Bergeron" algebraic "dc" circuit and find v_L, i_L, i_s



$\mathbf{v}_s = 188{,}000 \cos(2\pi 60\, t)$ volts

for $0 \le t \le 0.04$ sec using a time step of $\Delta t = \frac{1}{6}\frac{d}{\nu_p}$. Plot v_L.