ECE 460 Problem Set A
Do by April 9, 2025 (Not Turned In)

1. With a step size of Δt = 0.1 seconds use the Second Order Runge-Kutta method to determine the values of $x_1(t)$ and $x_2(t)$ at 0.2 seconds. Use initial (t=0) values of $x_1(0)$ = 0.8, $x_2(0)$ = 1.2.

$$\dot{x}_1 = \frac{2}{3}x_1 - \frac{5}{3}x_1 x_2$$
$$\dot{x}_2 = x_1 x_2 - x_2$$

2. Give all the equilibrium points for the Problem 1 system.

3. A 60 Hz generator is supplying 400 MW (and 0 Mvar) to an infinite bus (with 1.0 per unit voltage) through two parallel transmission lines. Each transmission line has a per unit impedance (100 MVA base) of 0.09j. The per unit transient reactance for the generator is 0.0375j, the per unit inertia constant for the generator (H) is 10 seconds, and damping (D) is zero (all with a 100 MVA base). At time = 0 one of the transmission lines experiences a balanced three phase short to ground one half (1/2) of the way down the line from the generator to the infinite bus (i.e., model the line with 1/2 its original impedance on the generator side and 1/2 on the infinite bus side).

   First, using the classical generator model discussed in class (constant voltage behind transient reactance), determine the prefault internal voltage magnitude and angle of the generator. Then, express the system dynamics during the fault as a set of first order differential equations. Last, using Euler's method, determine the generator internal angle at the end of the second timestep. Use a timestep of 0.02 seconds.

4. Book 12.24, 12.27, 12.29