Exercises lecture 1

1. Check the stability of the system

$$\dot{x} = -y - x^3$$
$$\dot{y} = x - y^3$$

Using Lyaponov direct method with the candidate Lyapunov function

$$V = x^2 + y^2$$

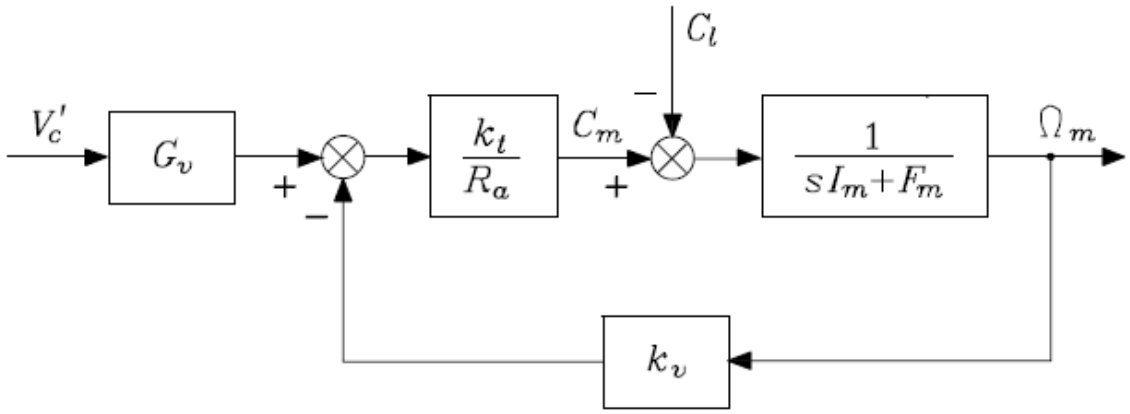
2. Check the stability of the system

$$\dot{x} = y - x - xy^2$$
$$\dot{y} = -2x - y - yx^2$$

Using Lyaponov direct method with the candidate Lyapunov function

$$V = x^2 + \frac{1}{2}y^2$$

3. Find the transfer function of the block diagram



4. Modify the above block diagram to include a feed forward loop for the model $G(s) = \frac{1}{sI_m+F_m}$
5. Find the poles of the transfer function in 3. Is the system stable?
6. Check the stability of the system

$$M(s) = \frac{k_m}{s(1+sT_m)}$$

7. Check the stability of the state space system

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -\frac{k}{m} & -\frac{f}{m} \end{bmatrix} x$$