This is EE 610

1st will investigate using PSpice to solve ODE

$$\dot{x}_1 = x_2 \qquad\qquad \dot{\ } = d/dt$$

$$\dot{x}_2 = -\omega_0^2 x_1 - f(x_2)$$

to see what this is

$$\ddot{x}_2 = -\omega_0^2 \dot{x}_1 - \frac{df(x_2)}{dx_2} \cdot \dot{x}_2$$

$$= -\omega_0^2 x_2 - \frac{df(x_2)}{dx_2} \cdot \dot{x}_2$$

or

$$\ddot{x}_2 + \underbrace{\frac{df}{dx_2}}_{\text{damping}} \cdot \dot{x}_2 + \omega_0^2 x_2 = 0$$

choose $\dfrac{df}{dx_2} = \epsilon(x_2^2 - 1)$

or $f(x_2) = \dfrac{\epsilon}{3} x_2^3 - \epsilon x_2 + \underbrace{\text{constant}}_{\text{choose } = 0}$

$$= \epsilon x_2\left(\frac{x_2^2}{3} - 1\right)$$

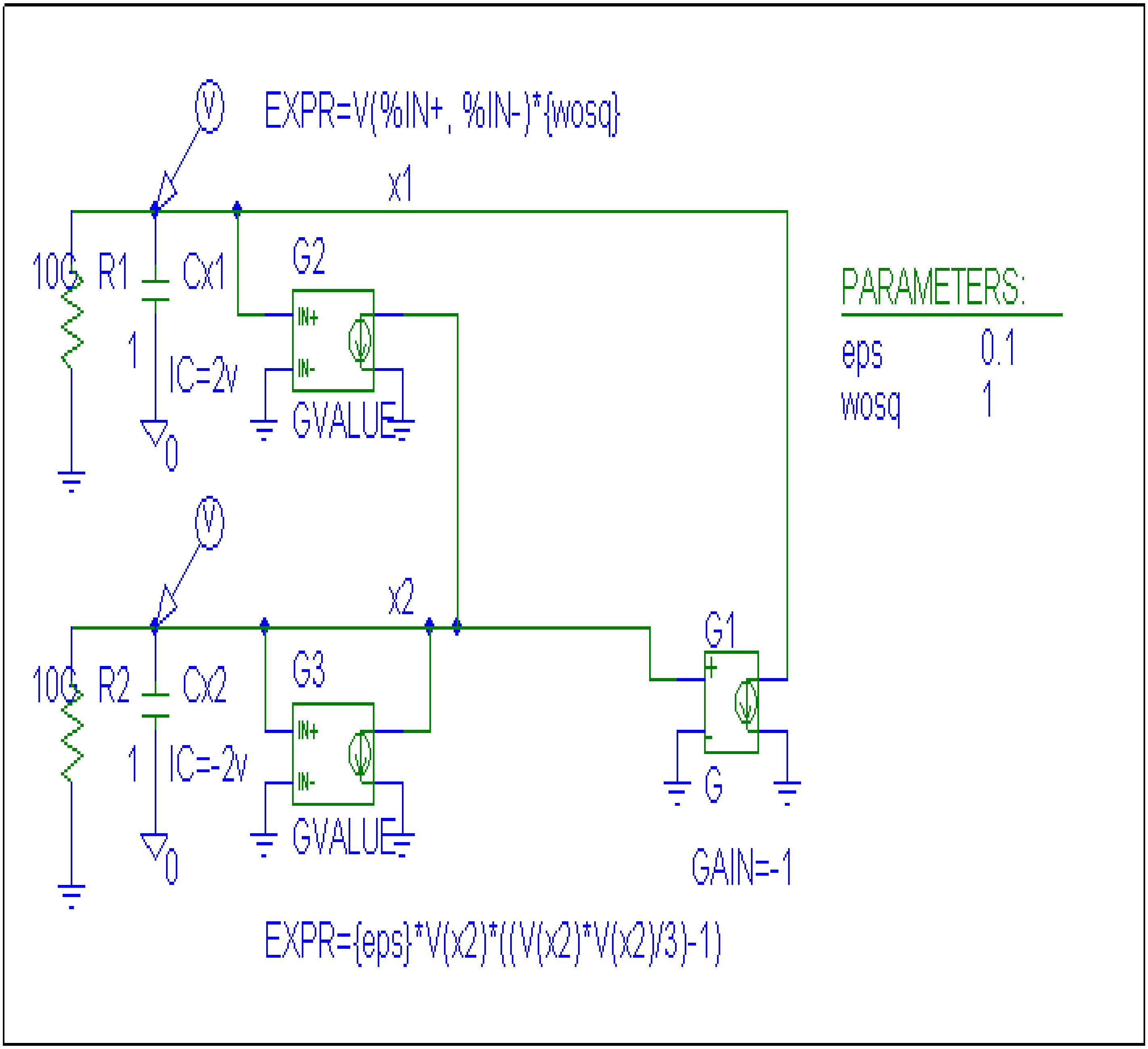
gives $\ddot{x}_2 + \epsilon x_2\left(\dfrac{x_2^2}{3} - 1\right)\dot{x}_2 + \omega_0^2 x_2 = 0 \Leftarrow$ Van der Pol oscillator

This is a nice oscillator

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -\omega_0^2 x_1 - \epsilon x_2\left(\frac{x_2^2}{3} - 1\right)$$

now set up in PSpice


EXPR=V(%IN+, %IN-)*{wosq}
x1
10G
R1
Cx1
1
IC=2v
0
G2
IN+
IN-
GVALUE
PARAMETERS:
eps 0.1
wosq 1
x2
10G
R2
Cx2
1
IC=-2v
0
G3
IN+
IN-
GVALUE
G1
G
GAIN=-1
EXPR={eps}*V(x2)*((V(x2)*V(x2)/3)-1)