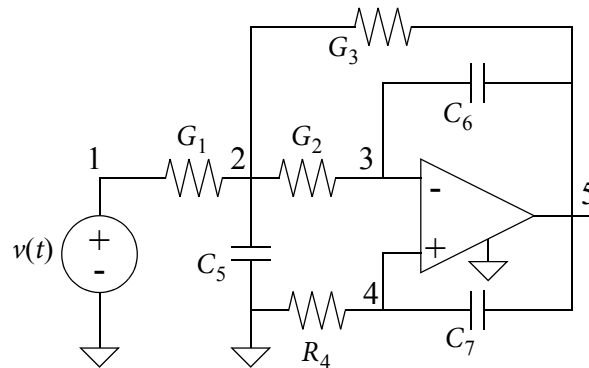




ECE 4390 Engineering Computations

Problem Set 1 - Computational Circuit Analysis

1. (From last year's exam) For the op-amp circuit below, set up the *modified nodal analysis* equations, both in the time domain and in the phasor-domain (use the node numbers indicated). Use the stamps discussed in class. If a resistor value is given as an impedance value, use the impedance form of the stamp for that element. Label all auxiliary currents that you need to introduce. Finally, for the time domain MNA formulation write the up-date equations you would use to solve the circuit numerically using both backward Euler and the trapezoidal rule for integrating the resulting ODEs. (Assume zero initial conditions.)



- 2) Write the following system of ODEs: $\dot{u}_1 = -tu_2$, $\dot{u}_2 = u_1/t$ as a system $\dot{\mathbf{u}} = \mathbf{f}(\mathbf{u}, t)$. Is \mathbf{f} a linear or a nonlinear function? Write up-date equations using Forward Euler, Backward Euler and the Trapezoidal method.
- 3) Consider the following circuit which includes a nonlinear capacitor (q is the charge on the capacitor). The initial voltage on the nonlinear capacitor is $v_1(0) = 2$ V. Write differential equations for the nodal voltages v_1 and v_2 as a system $\dot{\mathbf{u}} = \mathbf{f}(\mathbf{u}, t)$ and show that \mathbf{f} will be nonlinear. Write out up-date equations to solve this system using the Predictor-Corrector technique. Use Forward Euler for the predictor and Backward Euler for the corrector.

