18-11-2019

Name:

Surname:

Number:

Signature:

MECE 233 Midterm

Q1) For the circuit below using mesh current method write the mesh equations (just write the mesh equations, DO NOT SOLVE THEM) where I1, I2 and I3 stands for the mesh currents. **(10 points)**



Q2) For the circuit below using node voltage method write the node equation at node C (just write the node equations, DO NOT SOLVE IT). Also find node values of nodes A and B. The reference node G=0 Volt. **(10 points)**



Q3) Find the first order differential equation governing IL for the circuit below where IL is the current of the inductor and Iin is the applied input current to the circuit. **(10 points)**



Q4) A first order circuit is governed by the differential equation $\frac{dV\_{c}}{dt}+V\_{c}=e^{-t}$. The initial condition for the differential equation is VC(0)= 3 Volt. Find VC(t). **(10 points)**

**Hint:** The particular solution of this differential equation is in the form Vcp=Mte-t and the homogeneous solution of this differential equation is of the form Vch=Ke-t.

Q5) A function is given by the formula x(t)=r(t)-2r(t-1)+r(t-3)+u(t-3) where r(t) stand for the ramp function and u(t) stands for the unit step function. Draw x(t) and indicate important points and details in your plot. **(10 points)**



Q6) A series RLC circuit is given below. For the circuit find the second order differential equation governing VC. **(13 points)**



Q7) A second order circuit is governed by the differential equation $\frac{d^{2}V\_{c}}{dt^{2}}+2\frac{dV\_{c}}{dt}+Vc=1$. The initial conditions for the differential equation is VC(0)= 0 Volt and $\frac{dV\_{c}}{dt}\left(0\right)=0$.

1. Is this circuit in overdamped, critically-damped, under-damped or purely sinusoidal case. **(2 points)**
2. Find VC(t). **(8 points)**

**Hint:** The particular solution of this differential equation is in the form Vcp=K

Q8) A second order circuit is governed by the differential equation $\frac{d^{2}V\_{c}}{dt^{2}}+Vc=1$. The initial conditions for the differential equation is VC(0)= 0 Volt and $\frac{dV\_{c}}{dt}\left(0\right)=0$.

1. Is this circuit in overdamped, critically-damped, under-damped or purely sinusoidal case. **(2 points)**
2. Find VC(t). **(8 points)**
3. Design a circuit giving this differential equation. **(7 points)**

**Hint:** The particular solution of this differential equation is in the form Vcp=K

Q9) The capacitor Voltage Vc(t) of a second order circuit is given by the formula Vc(t)=8e-2t-3e-8t. Draw Vc(t) and indicate its important details in your plot. **(10 points)**