10-01-2019

MECE 233 Final

Name: Surname: Number: Signature:

Q1) Find the first order differential equation governing VC for the RC circuit below where Vin is the applied voltage source. **(15 points)**



Q2) For the circuit below: V1 = 20 Volt, V2 = 25 Volt, R1 = R2= 5 Ohm, R3 = 2 Ohm and G is the ground node. Find the voltage values of node A, B and C. **(15 points)**



Q3) For the circuit below, the following information are given about the initial conditions and circuit parameters: L1=1 Henry, L2=2 Henry, R =1 Ohm, IL1(0)=2 Ampere, IL2(0)=2.5 Ampere. The switch S is initially closed (when 0<t<ln2 seconds) and hence only L1 and R are interacting. Then switch S is opened (at t=ln2 seconds) and after this moment L2 also began to interact with L1 and R. Find the current IL(t) (the current passing from the main branch) when 0<t<ln2 seconds and when t>ln2 seconds. **(25 points)**

Hint 1: When t=ln2 seconds, the initial condition for the main branch current changes as

 $L\_{1}I\_{L1}\left(ln2^{-}\right)+L\_{2}I\_{L2}\left(ln2^{-}\right)=(L\_{1}+L\_{2})I\_{L}\left(ln2^{+}\right)$

Hint 2: when 0<t<ln2 seconds IL1 = IL, when t>ln2 seconds IL1 = IL2 = IL.

Q4) For the following 4th order circuit the following equations are valid:

VS=VC1+VL1,

VS=VC1+Vc2+VL2,

IC1=IL1+IL2

IC2=IL2

Convert these equations to first order differential equations and put the equations into a state space representation. **(31 points)**



Q5) A signal is given as A(t)=5 Cos(10t+$\frac{π}{2}$). Find its phasor representation $\overbar{A}$. **(4 points)**

**Hint:** If A(t)=K Cos(wt+θ) then $\overbar{A}=Ke^{jθ}=K(cos⁡(θ$)+jsin(θ))

Q6) A differential equation governing a circuit is given by $\frac{dx^{3}}{dt^{3}}+\frac{dx^{2}}{dt^{2}}+3\frac{dx}{dt}+3x=u$

1. What is the characteristic equation? **(2 points)**
2. What are the natural frequencies? **(2 points)**
3. What is the parametric form of the homogeneous solution (do not find the parameters)? **(2 points)**
4. If input u=5Cos(3t) what is the parametric form of the particular solution (do not find the parameters)? **(2 points)**
5. If input u=5Cos($\sqrt{3}$t) what is the parametric form of the particular solution (do not find the parameters)? **(2 points)**