04-01-2018

MECE 233 Final

Name:

Surname:

Number:

Q1) For the circuit below find the power delivered to the circuit by the dependent Voltage source VS2. The circuit parameters are as follows: R1=R2=R3=R4=1 Ohm, VS1=10 Volt, VS2=5VK Volt (VK is the voltage drop over R3). **(15 points)**



Q2) For the circuit below find V-I characteristics and plot it on the graph below: **(15 points)**

 

Q3) For the circuit below VC1, VC2, IL are the state variables and IS is the applied input to the system

1. Find the state space representation of this circuit where the states are represented by the vector [VC1 VC2 IL]T. **(8 points)**
2. Let C1=C2=1 Farad, L= 2 Henry, with these set values find the characteristic equation and natural frequencies of the circuit. **(8 points)**
3. Find the third order differential equation governing VC1.**(14 points)**

Q4) A circuit variable is defined by the differential equation $\frac{d^{3}x}{dt^{3}}+\frac{dx}{dt}=5t$.

1. Find the characteristic equation. **(2 points)**
2. Find the natural frequencies. **(2 points)**
3. Parametrically propose a homogeneous xh(t) solution for the differential equation. **(2 points)**
4. Show that the particular solution of the differential equation is xp(t)=2.5t2. **(2 points)**
5. The initial conditions of the differential equation are given as x(0)=1, x’(0)=1, x’’(0)=1. Knowing that x(t)=xh(t)+xp(t) use the initial conditions and find parameters coming from the homogeneous part of x(t) and obtain function x(t). **(8 points)**

Q5) For the circuit below VS1=2Cos(wt) Volt, VS2=1Cos(wt+$\frac{π}{2}$) Volt where angular frequency w=1 rad/sec, R=2 Ohm, L1=L2=1 Henry, C=1 Farad. Using phasors obtain the sinusoidal steady state value of VL. **(10 points)**



Q6) For the circuit below VS1=Cos(w1t) Volt, VS2=Sin(w2t) Volt where angular frequencies w1=1 rad/sec and w2=2 rad/sec. R=2 Ohm, L=1 Henry, C=1 Farad. Using phasors obtain the sinusoidal steady state value of VL. **(BE CAREFUL w1**$\ne $**w2) (14 points)**



**Notes for phasors:**

**Phasors for circuit elements: Phasors for sources (after writing it as a Cosine function):**

**R**$\rightarrow $**XR=R, C**$\rightarrow $**XC=**$\frac{1}{jwC}$**,L**$\rightarrow $**XL=jwL x(t)=Cos(wt+θ)**$\rightarrow \overbar{x}=e^{jθ}$**=cos(θ)+jSin(θ)**

**where w is input angular**

**frequency**