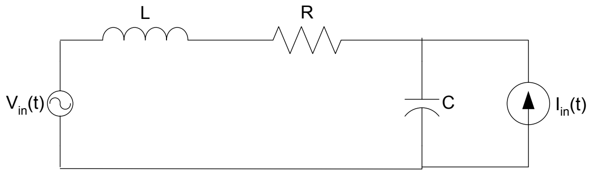
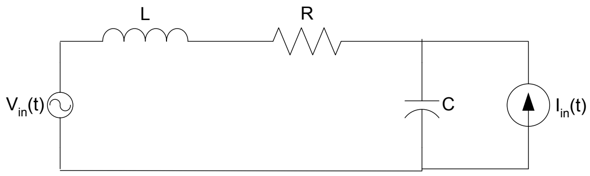
26-04-2014

ECE 232 Midterm

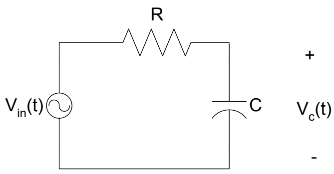
Q-1- For the circuit below, find the **average power** dissipated over the resistor R in **sinusoidal steady state conditions**. $V_{in}(t)$ = Sin(t) Volt, $I_{in}(t)$ = Cos(t) Ampere, R = 1 Ohm, L = 1 Henry, C = 1 Farad **(20 points)**



Q-2- For the circuit below, find the **average power** dissipated over the resistor R in **sinusoidal steady state conditions**. $V_{in}(t)$ = Sin(t) Volt, $I_{in}(t)$ = Cos(2t) Ampere, R = 1 Ohm, L = 1 Henry, C = 1 Farad **(20 points)**



Q-3- For the circuit below, **R = 1 Ohm, C= 1 Farad, $V_{in}(t)$ = Sin(t) Volt,** the initial condition for the capacitor voltage **$V_C(0)$ = 1 Volt.** Using **Laplace Transform,** find V_C**(t). (20 points)**



Q-4- The transfer function of a bandpass filter is given by the formula $H(s) = \dfrac{1000s}{(s+500)^2}$ **(40 points)**

a) Find $H(jw)$ (the frequency response) **(2 points)**
b) Find $|H(jw)|$ (the magnitude characteristics of the frequency response) **(2 points)**
c)
d) Find $\angle H(jw)$ (the phase characteristics of the frequency response) **(2 points)**
e)
f) Find $|H(jw)|_{dB}$ (the magnitude characteristics of the frequency response in decibel) **(2 points)**
g) What is the resonant frequency of this band-pass filter? **(3 points)**
h) What are the corner frequencies of this band-pass filter **(5 points)**
i) Draw approximated $|H(jw)|_{dB}$ in logarithmic scale with all details. **(10 points)**
j) Draw approximated $\angle H(jw)$ in logarithmic scale with all details. **(14 points)**

LAPLACE TRANSFORM FORMULAS

$$x(t) = u(t) \xrightarrow{L} X(s) = \frac{1}{s}$$

$$x(t) \xrightarrow{L} X(s) \Rightarrow \frac{d}{dt}x(t) \xrightarrow{L} sX(s) - x_0$$

$$x(t) = r(t) \xrightarrow{L} X(s) = \frac{1}{s^2}$$

$$x(t) = e^{at}u(t) \xrightarrow{L} X(s) = \frac{1}{s-a}$$

$$x(t) = \sin(wt)u(t) \xrightarrow{L} X(s) = \frac{w}{s^2 + w^2}$$

$$x(t) = e^{at}\sin(wt)u(t) \xrightarrow{L} X(s) = \frac{w}{(s-a)^2 + w^2}$$

$$x(t) = \cos(wt)u(t) \xrightarrow{L} X(s) = \frac{s}{s^2 + w^2}$$

$$x(t) = e^{at}\cos(wt)u(t) \xrightarrow{L} X(s) = \frac{s-a}{(s-a)^2 + w^2}$$

PHASOR TRANSFORM FORMULAS

$R \xrightarrow{PHASOR} X_R(jw) = R$ (Impedance of resistor)

$L \xrightarrow{PHASOR} X_L(jw) = jwL$ (Impedance of Inductor)

$C \xrightarrow{PHASOR} X_C(jw) = \frac{1}{jwC}$ (Impedance of capacitor)

$$x(t) = A\cos(wt + \phi) \xrightarrow{PHASOR} x_{phasor} = Ae^{j\phi} = A(\cos(\phi) + jSin(\phi))$$